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LEAD POISONING IN CATTLE AND SHEEP *

BY

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The danger of paint and other lead compounds to the bovine is well recognised and has been recorded and discussed fairly extensively from time to time. The literature indicates that the calf is extremely susceptible to lead poisoning (White & Cotchin, 1948; Fenstermacher *et al.*, 1946; Shrewsbury *et al.*, 1945; Steyn, 1940), but relatively little has been reported regarding the levels of lead in tissues of animals which have died as a result of lead poisoning, and still less in animals suspected of suffering from sub-lethal doses of lead compounds. In order to provide sufficient data to enable interpretation of figures obtained from tissues in cases of suspected lead poisoning sent in from the field, and to provide information on the metabolic fate of lead in ruminants, investigations were made at Weybridge on the absorption, excretion, retention and general metabolic effects of lead in both cattle and sheep and the results have been published by Blaxter and Allcroft (1950) in a series of five papers. In this brief review it is intended to discuss points from these and subsequent investigations which are likely to be of interest to the veterinarian.

The enormous amount of work done in connection with lead poisoning in the human subject and small laboratory animals has been extensively reviewed by Cantarow and Trumper (1944) and others and there is no need to refer to it in detail here. The general principles regarding the pathological physiology of lead poisoning are similar in all species, but since in farm animals we are nearly always concerned with acute lead poisoning while in the human this is rare, interpretation of data has to be considered from a different aspect from that usually dealt with when the hazard is to human health. I propose to leave details of clinical symptoms and *post-mortem* findings to Mr. Loosmore, who is opening the discussion. Before going on to consider amounts of lead found in tissues after ingestion of various lead compounds it may be of interest to discuss very briefly some relevant points regarding absorption, excretion and deposition of lead in the body.

In farm animals lead enters the body most commonly through the mouth, although in a few industrial areas there may be slight absorption from the respiratory tract. Cutaneous absorption is rare and is of no practical significance in lead poisoning. The question of subcutaneous absorption is sometimes raised in connection with pieces of metal lodged in tissues, but although slight absorption might possibly occur, it would be extremely unlikely to give rise to any clinical symptoms.

The concentration of lead found in the various tissues depends considerably on the portal of entry. Inhalation of lead dust or fumes results in relatively high concentrations in the blood and tissues within a few hours or days, while oral ingestion of larger amounts over longer periods may give only low concentrations. Regarding absorption from the alimentary tract it is known that only a small proportion of the amount ingested is absorbed, most of it being eliminated in the faeces. This is true whether lead is given as the water-soluble lead acetate or as the insoluble carbonate, the form in which lead is present in paint. The reason for this is that water-soluble lead compounds react with the contents of the alimentary tract to form insoluble lead complexes, including protein compounds. Most lead compounds insoluble in water, however, are dissolved to a small extent in the alimentary tract, although the rate of solution of some, such as the ore galena, is so slow that little danger results from ingestion. Results of metabolism experiments on sheep carried out by Blaxter (1950) indicated an absorption of only 1 to 2 per cent. both for the water soluble acetate and the insoluble carbonate. Although absorption is very small, it is reasonable to assume that it depends on the rate of solubility of the ingested compound in the alimentary tract.

When lead is absorbed, most of it appears to enter the portal circulation, reaches the liver and is gradually excreted by the bile into the intestine and thence eliminated in the faeces. A little may be reabsorbed from the intestine involving a limited hepatic-intestinal circulation. A small proportion of absorbed lead is also excreted by the kidney, and urinary lead values are therefore a useful index of absorption. Blaxter (1950) showed that urinary excretion of lead in sheep was dependent on lead intake, but was not directly proportional to it, and even when large quantities were given did not exceed 0·8 mg. daily. Although high urinary values are generally associated with high blood values, there is no strict parallelism and for diagnostic purposes in the bovine, blood samples are more useful and usually easier to obtain.

Lead is also excreted in the milk of lactating animals and this, too, represents lead which has been absorbed. Blaxter (1950) found a relatively high excretion of lead in the ewe, higher than has been reported either in the cow (Kehoe *et al.*, 1940) or in man (Bagchi *et al.*, 1940).

The principal channel of elimination of ingested lead is, as stated, by the faeces. Faecal lead represents unabsorbed lead with a variable proportion of re-excreted lead, and figures obtained from faecal samples from animals suspected of suffering from lead poisoning can give valuable diagnostic information if considered in conjunction with blood lead levels. This point will be discussed in more detail later.

As stated before, the concentration of lead found in the various tissues depends considerably on the portal of entry as well as on the quantity and nature of the lead compound and length of duration of exposure. After continuous oral

* Presented to South-Eastern Division, N.V.M.A., at Tunbridge Wells, May 24th, 1951.

administration the largest amounts are found in the bones, smaller amounts in the liver and kidneys and the lowest concentrations in heart, lungs, muscles and brain. In cases of acute lead poisoning relatively smaller amounts are found in the bones, the highest values being shown by liver and kidneys, particularly the kidney cortex. There are wide discrepancies in the reported lead content of nervous tissue, especially in the earlier literature, but the more accurate methods now used for estimating lead indicate that there is no special localisation in the central nervous system.

After long-continued exposure to industrial hazard there is often, but not always, present in man a line or band of blue-black discoloration in the gums, *i.e.*, the so-called "lead line." This discoloration has been shown to be due to the presence of a large number of minute granules which are believed to be precipitated particles of lead sulphide. This "line" has been reported in experimental carnivorous animals, but not in herbivora. It is of interest that there is no sign of discoloration in the gums of bovines at Weybridge that have been on a high daily intake of lead over the last five years and are now getting 6 g. of lead daily, either as the carbonate or sulphide.

The effect of lead on reproduction has been investigated by many workers and the passage of lead from the maternal circulation to the foetus has been demonstrated repeatedly. A limited number of experiments carried out at Weybridge confirmed the placental transference of lead in the ewe. A liver value as high as 37 parts per million (p.p.m.) was found in the foetus of a ewe which died three weeks before lambing and which had received 50 mg. Pb as the acetate daily during the gestation period. The livers of five "swayback" lambs from ewes grazing in the vicinity of old lead raikes in Derbyshire showed lead figures of 4 to 8 p.p.m., while livers of lambs from ewes grazing pastures of normal lead content had values of less than 1 p.p.m.

Lead in Tissues

After this general discussion it may be as well to consider in more detail the concentration of lead found in selected tissues of bovines after ingestion of various doses of lead compounds (Allcroft, 1950). First it was necessary to obtain a range of tissue values in "normal" animals, *i.e.*, animals which had never had access to abnormal quantities of lead. For this purpose kidney and liver tissues were taken from 31 cattle ranging in age from six months to seven years. The figures for both tissues were very similar, ranging from 0·3 to 1·5 p.p.m. on the wet tissue. Comparison of the data with those obtained from normal human beings shows good agreement since more recent results reported by Cantarow and Trumper (1944) indicated that the lead content of normal human liver and kidney was unlikely to exceed 2 p.p.m. In this respect Fenstermacher *et al.* (1946) in studies of lead poisoning in cattle have regarded liver values of up to 3 p.p.m. as within the normal range.

A similar study made of the levels of lead in the whole blood of goats, sheep, horses, cows and young calves showed values ranging from 0·05 to 0·25 p.p.m. (mg. per litre) with a mean of 0·13 p.p.m. for 30 calves and similar means for the other animals. Faecal lead values obtained from 14 normal calves ranged from 1·5 to 30 p.p.m. on a dry matter basis with a mean of 12 p.p.m.; the range for 12 normal cows was 6 to 35 p.p.m. with a mean of 13 p.p.m.

The effects of lead ingestion on the concentration of lead in blood, tissues and faeces are shown in the following graphs and tables (Allcroft, 1950).

In Fig. 1, typical results are shown of blood lead values in cases of poisoning from ingestion of lead paint and Fig. 2 shows similar results obtained after dosing with water-soluble lead acetate.

It is clear that after ingestion of lead compounds there was a considerable and rapid rise in the amount of lead in the blood. In the case of sublethal doses of the acetate there was a fairly rapid fall to lower levels but instead of returning to normal within a few days figures remained well above it for weeks. This abnormal elevation is well illustrated in Fig. 3, where *six months* after ingestion of a single sublethal dose of 30 grammes of wet paint, equivalent to 15·7 grammes Pb, the blood value of 0·27 p.p.m. was still slightly higher than the pre-experimental value of 0·15 p.p.m.

It is of interest that in the case of one older calf (No. 856, Table II) the very high blood lead value of 4 p.p.m. was observed 50 days after ingestion of a total of 236 g. of lead as the basic carbonate in two doses spaced six weeks apart. In spite of this remarkably high value and exhibition of symptoms of lead poisoning this calf survived and was killed three and a half months later when the blood lead value had fallen to 1·4 p.p.m. and the calf appeared clinically normal.

Table I

Lead Content of Selected Tissues of Calves which Died after Large Doses of Various Lead Compounds

Calf number	Age	Form of lead	Dose (g. per kg. body-weight)	Lead content (mg. per kg. or p.p.m.)						
				Liver	Kidney		Spleen	Lung	Heart	Brain
					Cortex	Medulla				
775	6 months	Wet white lead paint	0·84	75·4	253·0	32·0	5·7	—	—	1·3
781	6 "	" "	1·10	126·0	144·0	24·5	4·5	—	—	1·0
862	14 weeks	" "	0·25	45·0	297·0	—	2·2	3·6	1·0	<1·0
881	4 "	Dry paint flakes	0·23	15·5	200·0	4·6	1·0	2·3	<1·0	<1·0
865	10 "	Basic lead carbonate	0·24	34·0	230·0	—	3·3	3·3	1·3	1·2
891	7 "	" "	0·22	27·0	260·0	4·0	2·3	2·4	1·3	1·4
922	7½ "	Lead oxide	0·25	24·3	132·0	4·2	<1·0	2·0	<1·0	<1·0
951	10 "	" phosphate	0·50	9·3	87·0	4·7	1·2	—	—	—
976	6 "	" "	0·25	11·1	50·5	3·0	1·7	—	—	—
778	10 months	" nitrate	—	9·7	72·0	5·5	3·0	2·3	1·0	1·5

BLOOD LEAD VALUES OF CALVES AFTER A SINGLE DOSE OF LEAD AS PAINT.

Fig 1

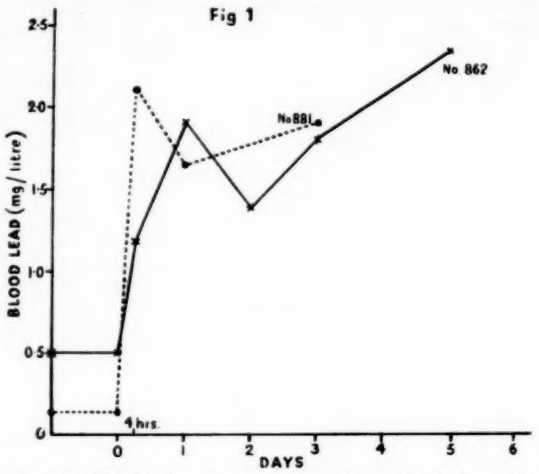

Fig. 1.—Blood lead values for two calves after a single dose of lead as paint. ●- - - -● calf No. 881, aged four weeks, given 13·6 g. Pb as dry paint flakes (0·23 g. Pb/kg. bodyweight). X——X calf No. 862, aged 3½ months, given 31·4 g. Pb as wet paint (0·25 g. Pb/kg. bodyweight). (The high initial blood value in this animal was due to its use in a previous lead experiment.)

BLOOD LEAD VALUES IN CALVES AFTER A SINGLE DOSE OF LEAD AS ACETATE.

Fig 2

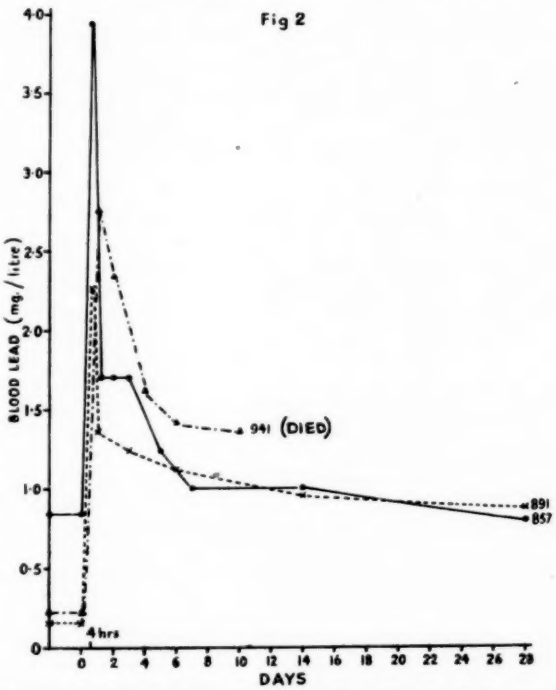

Fig. 2.—Blood lead values for three calves after a single dose of lead as acetate. ●——● calf No. 857, aged eight months, given 80 g. Pb as acetate (0·52 g. Pb/kg. bodyweight). Survived. ×- - -× calf No. 891, aged 12 days, given 13·6 g. Pb as acetate (0·35 g. Pb/kg. bodyweight). Survived. ▲——-▲ calf No. 941, aged two days, given 10·5 g. Pb as acetate (0·35 g. Pb/kg. bodyweight). Died on 12th day. (The high initial blood value in calf No. 857 was due to its use in a previous lead experiment.)

Fig 3

BLOOD LEAD VALUES IN A CALF AFTER A SINGLE SUB-LETHAL DOSE OF LEAD AS PAINT, SHOWING TIME TAKEN TO RETURN TO NORMAL.

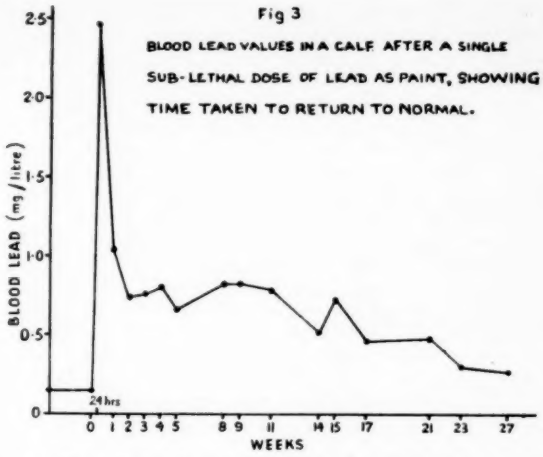

Fig. 3.—Blood lead values for calf No. 869, aged three months, given a single sub-lethal dose of lead (15·1 g.) as wet paint (0·12 g. Pb/kg. bodyweight). Survived. This graph illustrates the time taken for the blood lead level to return to normal.

BLOOD LEAD VALUES FOR FOUR CALVES AFTER A SINGLE DOSE OF LEAD AS THE ORE GALENA OR AS THE METAL.

Fig 4

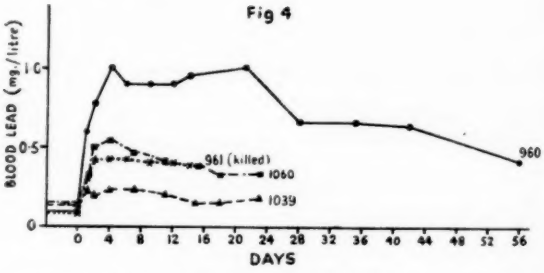

Fig. 4.—Blood lead values for four calves after a single dose of lead as the ore galena or as the metal. ●——● calf No. 960, aged 7½ weeks, given 46·6 g. Pb as finely ground galena (0·5 g. Pb/kg. bodyweight). ×- - - -× calf No. 961, aged 7½ weeks, given 15·9 g. Pb. as finely ground galena (0·25 g. Pb/kg. bodyweight). Killed on 16th day for analysis of tissues. ▲- - - -▲ calf No. 1039, aged four months, given 100 g. Pb as lead shot (0·5 g. Pb/kg. bodyweight). ■——■ calf No. 1060, aged 4 months, given 70 g. Pb as fine metallic dust (0·5 g. Pb/kg. bodyweight).

Fig. 4 shows blood lead levels after ingestion of a single dose of lead as the ore galena or as the metal. It can be seen that absorption was much less than when similar quantities of lead were given as the acetate or carbonate.

Table I shows the elevated lead content of selected tissues of calves which died after being given large quantities of lead.

It can be seen that by far the highest concentrations were found in kidney cortex and liver tissue as would be expected from observations reported in the literature. It will be noticed that in every case the kidney cortex values are greater, sometimes six to nine times, than the liver values, and very much greater than kidney medulla values.

Results obtained by the slaughter of five animals given amounts of lead which were not sufficient to cause death are given in Table II.

Direct comparison of these figures with those in Table I are difficult since, as can be seen from blood levels in Fig. 4, absorption of lead after ingestion of galena and lead as the metal was smaller than after other lead compounds. Calf No. 856 was not slaughtered until it was certain that it would survive the amount of lead administered, so the tissue concentrations refer to a much later date after dosage than do those for the calves in the previous table. However, it is of interest that a six-month-old calf can survive even when kidney cortex lead is as high as 39 p.p.m., 110 days after a large dose of lead. If this calf had been killed a few days after dosing it is probable that the kidney cortex value would have been very much higher than 39 p.p.m.

Consideration of these figures will show that kidney and liver tissues are most suitable for diagnostic purposes, but that it is obviously difficult to fix a definite value above which it could be stated that death was due to lead poisoning. The figures do indicate, however, that kidney cortex values are of most use since some comparatively low liver values, 9·3, 9·7 and 11·1 p.p.m. for calves 951, 778 and 976 respectively (Table I) were obtained even after death from acute lead poisoning, while in the case of No. 754 (Table II) an almost equally high value of 6·9 p.p.m. was obtained after continued ingestion of small amounts of lead as soil dust with no clinical symptoms at all.

As previously stated, useful information can be obtained from a study of blood and faecal levels in surviving animals in which lead poisoning is suspected. Illustrative data are given in Table III showing values obtained after administration of sublethal doses of lead as galena and acetate.

It can be seen that even when faecal lead values had returned to normal, blood values still remained abnormally high. This can be of considerable diagnostic value since if both blood and faecal values are elevated it can be assumed that ingestion of lead occurred within the recent past, that is, within three to four weeks; or within two weeks if the soluble lead acetate has been ingested, although it is very unlikely that lead as the acetate would be encoun-

TABLE II

LEAD CONTENT OF SELECTED TISSUES OF CALVES WHICH SURVIVED ATTEMPTS TO POISON THEM WITH LEAD COMPOUNDS

Calf number	Age	Form of lead	Dose (g./kg. body-weight)	Time of slaughter (days after last dose)	Lead content (mg./kg.)							
					Blood (mg./l.)	Liver	Kidney		Spleen	Lung	Heart	Brain
							Cortex	Medulla				
856	6 months	Basic lead carbonate	*	110	1·36	6·5	39·0	3·7	2·0	1·0	1·0	2·9
961	7½ weeks	Galena	0·25	15	0·38	1·5	1·5	1·0	1·0	—	—	—
1,060	4 months	Lead as the metal (fine dust)	0·5	14	0·32	3·3	3·7	—	—	—	—	—

* A total of 236·9 g. of lead had been ingested by this calf in two periods spaced six weeks apart.

THE EFFECT OF THE INGESTION OF SMALL QUANTITIES OF LEAD AS PLUMBIFEROUS SOIL DUST AND LEAD TAILINGS ON THE CONCENTRATION OF LEAD IN THE TISSUES

Calf number		753	754
Length of treatment		169 days	125 days
Nature of material fed		Tailings	Dust
Total amount of material given		11·4 kg.	5·3 kg.
Percentage Pb content of material ingested		0·2	2·0
Total lead ingested		17·1 g.	104·8 g.
Lead content in mg./kg. of:	Liver	2·9	6·9
	Kidney cortex	3·2	10·7
	" medulla	1·0	1·1
	Humerus head	51·5	—
	" shaft	29·8	—
	Other tissues	<1·0	<1·0

TABLE III

LEAD IN BLOOD AND FAECES AFTER ADMINISTRATION OF SUB-LETHAL DOSES AS FINELY GROUND GALENA AND AS THE WATER-SOLUBLE ACETATE

Calf 960 Lead as galena given at the rate of 0·5 g./kg. bodyweight Total Pb 46·6 g.			Calf 936 Lead as the acetate given at the rate of 0·2 g./kg. bodyweight Total Pb 6 g.		
Time after ingestion	Blood Pb (mg./l.)	Faecal Pb (mg./kg. dry matter)	Time after ingestion	Blood Pb (mg./l.)	Faecal Pb (mg./kg. dry matter)
Before	0·10	3	Before	0·08	15
2 weeks	0·96	1,220	1 day	1·22	103,800
3 "	1·0	1,168	2 days	1·04	14,800
4 "	0·66	146	3 "	0·90	1,100
5 "	0·66	45	4 "	1·06	568
6 "	0·64	20	9 "	0·78	64
8 "	0·42	11	14 "	0·70	30

tered under farm conditions. If blood lead is high but faecal lead is normal, then ingestion probably occurred a considerable time before and there would be very little danger of the animal dying from lead poisoning. It would be possible, of course, to have a high blood lead value and a normal faecal value a few hours after ingestion of the lead compound and before unabsorbed lead had reached the anus, but in this case it would be too early to observe any suspicious symptoms in the animal and lead poisoning would therefore not be suspected.

Cumulative Lead Poisoning

This is well known in man and has been reported in experimental cats and dogs, but there is little evidence at present that it occurs to any extent in cattle and sheep. However, it is possible that a continuous ingestion of small quantities of lead might occur, due to the flaking of lead paint from food receptacles and stalls, contamination of rations with lead from plumbiferous soil or from processing machinery, or the lodging of lead metal in the digestive tract. One of the most commonly suspected causes of cumulative lead poisoning in farm animals is contamination of water supplies passing through lead pipes, but although we have examined many suspected samples of water, we have not yet found any in which the lead content was high enough to be harmful. It may be of interest to mention that the largest tolerated amount in drinking water for humans has been variously reported to range from 0·35 to 2 p.p.m. (mg. per litre) (Cantarow & Trumper, 1944). Ingleson (1938) has estimated that the average daily intake of lead in drinking water in Britain is about 0·2 mg. He also states that the general opinion is that 0·3 mg. per litre is a safe concentration, that 0·5 mg. is permissible and that 0·7 mg. per litre is likely to cause chronic lead poisoning in humans.

Several long-term experiments were undertaken at Weybridge to obtain some information on cumulative lead poisoning in cattle and sheep. The effect on haemoglobin and blood lead levels of lead ingested in the drinking water is shown in Fig. 5.

This steer (No. 778), aged eight to ten months at the commencement of the experiment, was given water containing 100 p.p.m. Pb as the nitrate. It is extremely unlikely that farm water supplies would ever reach such levels except through gross contamination by industrial effluent; it is certain that such levels would never occur in water supplies flowing through lead pipes. The calf survived for four months and, as shown in the graph, the lead content of the blood rose over the course of two to three months to ten times the pre-experimental level with a marked premortal increase. The total lead ingested during the four-month experimental period was 284 g., equivalent to 2·3 g. per day. The lead content of the tissues of this animal (No. 778) is shown in Table I. It is clear from this experiment that the ingestion of 2·3 g. of lead daily as the nitrate resulted in death in a relatively short time, but in view of the survival of three other animals on a higher daily intake over a longer period, it seems possible that the high concentration of nitrate as well as the lead in the drinking water caused the death of this animal in such a relatively short period. The results of two subsidiary experiments, in which smaller amounts of lead as road dust and tailings from an old lead mine were given to two steers over approximately the same period of time, are given in Table II. It can be seen that there was only slight deposition of lead in the tissues and the animals appeared clinically normal before they were killed.

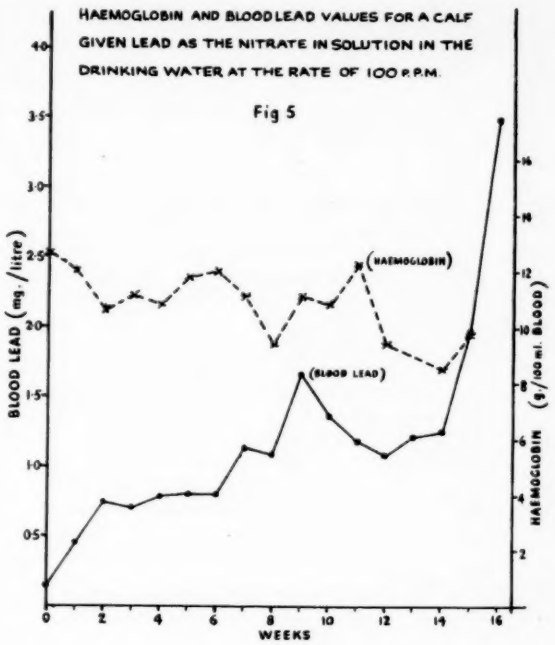

Fig. 5.—Haemoglobin and blood lead values for calf No. 778 (aged eight to ten months at commencement of experiment) given lead as the nitrate in solution in the drinking water at the rate of 100 p.p.m. Average daily intake was 2·3 g. Pb and approximate total intake over the experimental period of four months was 284 g. ×- - - -× haemoglobin. ●—— ● blood lead.

The effects of lead ingested in small quantities over a much longer period of time are shown graphically in Figs. 6, 7 and 8 (overleaf).

The plan of the experiments was to give each steer 1 g. of lead daily for 12 months, one animal (No. 855) to receive the acetate, one (No. 959) the basic carbonate and one (No. 960) the precipitated sulphide. After 12 months, dosage was increased at intervals of either six months or 12 months, these increases being shown on the graphs. The experiment with lead acetate lasted for 35 months; the other two are now in their fifth year. All the animals were three to four months old at the commencement of the experiment and blood samples were taken at fortnightly intervals throughout. The curves show that these small amounts of lead caused an initial rise in the blood concentration, followed, as the calves grew, by a slow fall to a " plateau " ten to 12 months after commencement of the experiment.

The steer which received lead as the acetate (Fig. 6) survived for 35 months and showed no clinical symptoms until the 33rd month, when it began to fall off badly in condition with loss of appetite. This loss of condition coincided with a marked decrease in haemoglobin values and increase in blood lead. During the last two months of life this animal did not show any of the symptoms characteristic of acute lead poisoning, except for the loss of appetite and constipation. There was no excitement or evidence of abdominal pain; the animal remained recumbent for the last four days and died quietly. It is of interest that the lead value for the kidney cortex of this steer was only 25 p.p.m., while values for liver and spleen were 48 and 43 p.p.m. respectively. The lead content of the bone is not yet available, but it is expected that it will be very high.

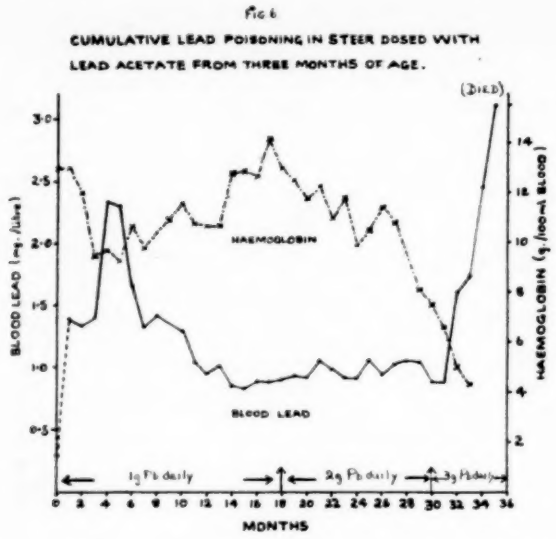

Fig. 6.—Calf No. 855. The effect on blood lead and haemoglobin values of the ingestion of small daily doses of lead as the water soluble acetate over a long period. × - - - - × haemoglobin ●——● blood lead.

The total amount of lead ingested by this animal during the 35 months of the experiment was approximately 1,600 g. or 3½ lb.

The long survival of the other two steers, which have been ingesting lead as the carbonate (Fig. 7) and the sulphide (Fig. 8) over four and a half years and have had a daily intake of 5 g. for the last year, is remarkable. The dose was increased to 6 g. of lead daily on April 1st, 1951, and there are still no signs of toxic symptoms in spite of the fact that they have already ingested a total of 4,500 g. Pb each, *i.e.*, approximately 10 lb. Pb! These two experiments are being continued until the animals die.

To investigate the possibility of lead poisoning of the chronic type following the lodging of metallic lead in the digestive tract, 400 g. lead shot was given to one calf (No. 1039) over a period of four months, while the other (No. 1060) was given 340 g. of fine metallic dust over the same period. Blood lead levels over the first 24 days are shown in Fig. 4. When calf No. 1039 was killed five months after the last dose, 84 per cent. of the shot were recovered from the digestive tract, most being found in the reticulum and very little in the rumen. Liver values from these two calves were 1·7 and 3·4 p.p.m. respectively and kidney cortex values were 2·9 and 3·8 p.p.m. These low tissue values, together with the comparatively low blood figures, indicate that there was very little absorption from the metal and that the possibility of lead poisoning in the

Fig. 7.

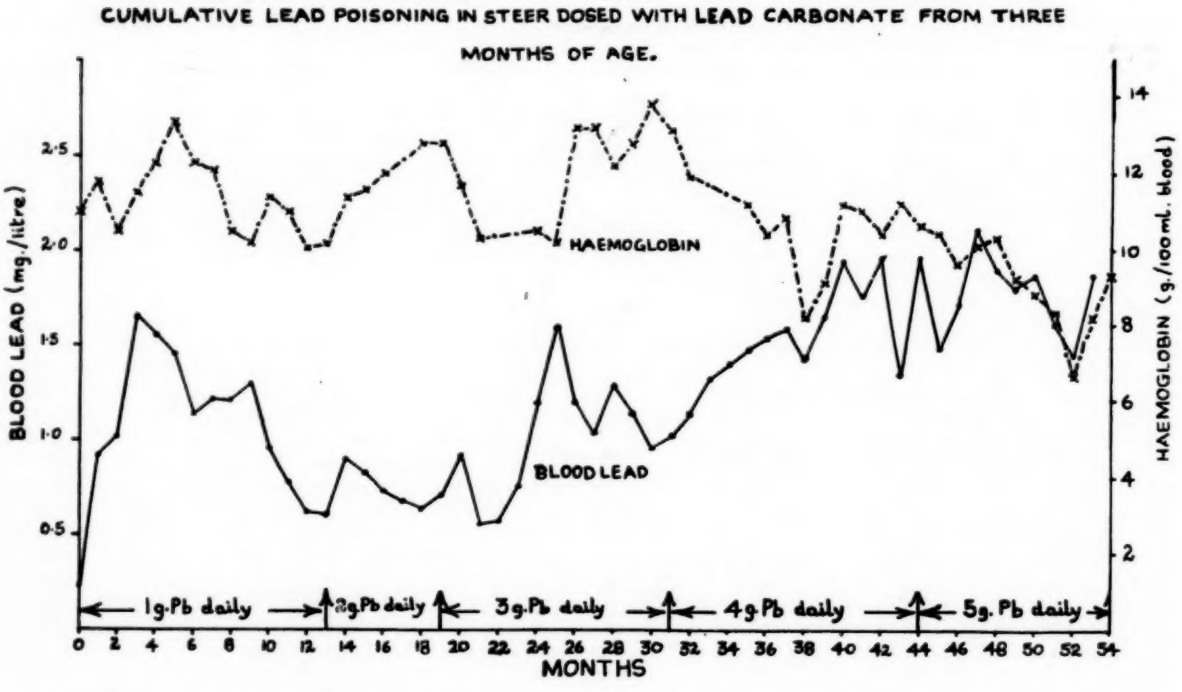

Fig. 7.—Calf No. 959. The effect on blood lead and haemoglobin values of the ingestion of small daily doses of lead as the carbonate over a long period. × - - - - - × haemoglobin. ●——● blood lead.

bovine from ingestion of metallic lead or the lodging of lead in the tissues is remote.

As regards chronic lead poisoning in sheep grazing over old lead mining areas, no abnormal symptoms have been observed in sheep after grazing from one to six years in the vicinity of old lead raikes in Derbyshire, with an estimated daily intake of about 50 mg. Pb and faecal lead values of 20 to 200 p.p.m. The mean lead content of blood samples from the same ewes from which faecal samples were obtained was 0·20 mg. per litre compared with a mean value of 0·14 mg. per litre from sheep from other areas. This very small increase indicates that very little absorption occurs as a result of grazing pastures contaminated with plumbiferous dust in the Derbyshire area. It is of interest, however, that abnormally high blood and tissue lead values have been obtained from " stiff " lambs born on a farm situated on an old lead mining area in the Pennines (Stewart & Allcroft, 1951). This condition is at present under investigation.

However, it is clear from the evidence obtained on calves and older bovines which had been fed galena or other lead compounds over extended periods, that chronic lead poisoning is extremely unlikely to occur in animals grazing pastures contaminated by plumbiferous dust.

Regarding the lethal dose of lead for cattle and sheep, data obtained at Weybridge indicate that approximately 0·2 to 0·4 g. per kg. bodyweight of lead ingested on any one day, either as the acetate, the basic carbonate (paint) or the oxide, is sufficient to cause death in calves up to four months of age, while in the case of older cattle and mature sheep, relatively larger doses are required.

It is clear, too, that, although the lead hazard to farm stock, especially bovines, is a very real one, it differs from the hazard to which the human subject is exposed. In the latter case, emphasis is usually placed on the danger of chronic poisoning from amounts of lead that would have no effect whatever on sheep and cattle in which the major and perhaps only danger appears to be that of *acute poisoning* by paint or painter's materials and rations which have become accidentally heavily contaminated with lead compounds.

The large number of samples sent to this laboratory from cases of suspected lead poisoning by relatively few veterinarians gives us some idea of the serious losses that must occur annually in calves. In 1950 material from one-third of 350 cases of suspected lead poisoning showed a lead content high enough to confirm lead poisoning. The habit of young calves of sucking and chewing the doors and walls of their pens and feeding troughs necessitates the restriction of paint containing lead to only those places where it cannot be reached by animals. The danger of painted woodwork should be emphasised to farmers as well as the necessity of disposing of rubbish, painted canvas, paint scrapings and other material which might contain lead, in such a way that no animal can gain access to it.

The diagnosis of lead poisoning in farm animals is best made by taking simultaneously into account the symptoms, the presence of a source of lead, the lead content of the blood and faeces if the animal survives, and if death occurs, the amount of lead in the tissues, especially the cortex of the kidney. Values higher than about 40 p.p.m. in the kidney cortex and 10 p.p.m. in the liver are of definite

FIG. 8

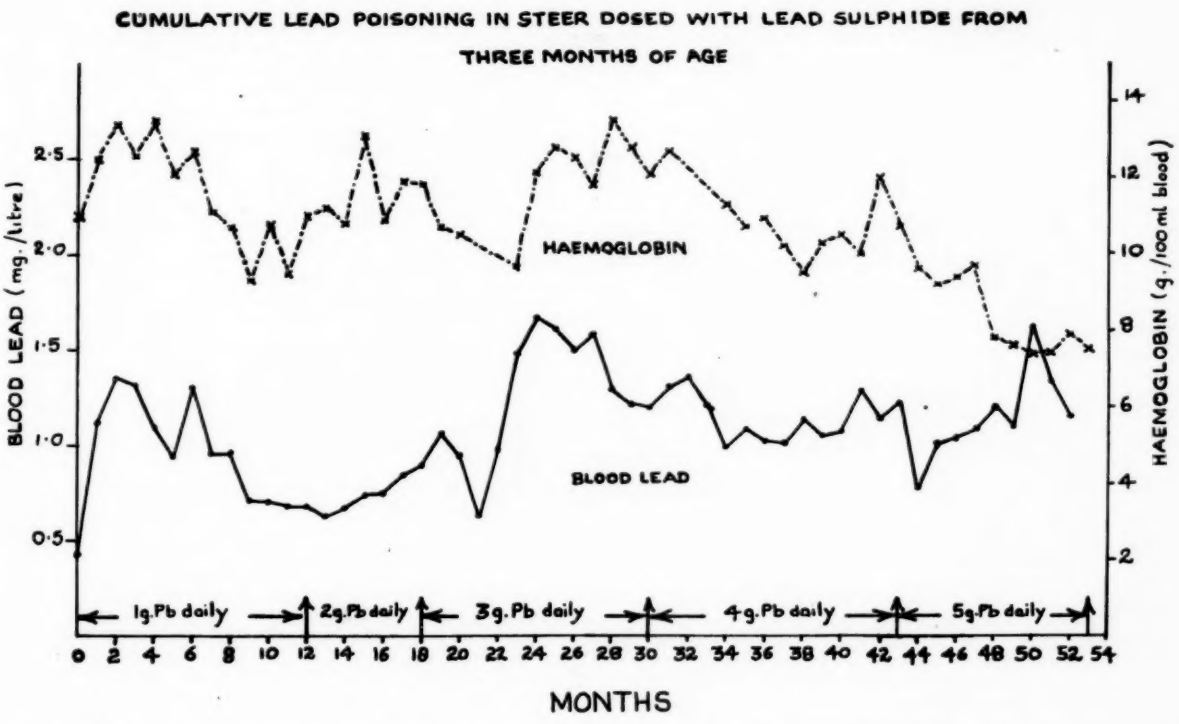

FIG. 8.—Calf No. 960. The effect on blood lead and haemoglobin values of the ingestion of small daily doses of lead as the precipitated sulphide over a long period. × - - - - × haemoglobin. ●—● blood lead.

diagnostic significance where there is collateral evidence of lead poisoning and would be highly suggestive in cases where there is not. It is sometimes difficult, however, to attempt to diagnose lead poisoning on the basis of analytical data alone. Thus, a value of 10 p.p.m. for liver may only mean that the animal has ingested abnormal amounts of lead in the fairly recent past, not that death was in actual fact due to lead poisoning. Similarly, faecal levels of lead have to be interpreted with caution. A value of 200 p.p.m. on dried faeces may only indicate the ingestion of plumbiferous soil dust, the lead of which is not easily absorbed, or it may represent the terminal stages in the elimination of a large amount of a more toxic lead compound, such as the basic carbonate contained in paint. Where analytical evidence is the only evidence available, it has been our practice to regard kidney cortex values of 40 p.p.m. or more on wet tissue, and liver lead concentrations of 20 p.p.m. or more, as sufficient to warrant a conclusion that lead poisoning has been the cause of death. Nevertheless, figures below this may be shown in cases of death following experimental administration of lead compounds (White & Cotchin, 1948).

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Opening of Discussion

Mr. R. M. Loosmore (Weybridge): I would like now to deal briefly with the symptoms, *post-mortem* findings and pathology of this condition. There are frequently no symptoms until an hour or two before death. Most often the animal is found in a fit or dead. Even experimental animals under observation seem normal until they start to bellow and stagger about with rolling eyes, and froth at the mouth before collapsing. There are intermittent convulsive phases until death occurs one to two hours after the commencement of the symptoms. The animals sometimes appear blind, try to climb walls, and in the quiet phase often stand with the head pushing against a wall when they do not react to any outside stimulus. In less acute cases the animals are dull with inappetence for several days. There is evidence of abdominal pain, grinding teeth and marked salivation; there is generally no diarrhoea, but more often constipation, and if faeces are passed they have a typical smell. Similar symptoms are seen in older animals.

Post-mortem Findings.—In experimental animals examined fresh there is frequently very little to see on *post-mortem* examination. However, most cases are seen some time after death, and in these, although lesions are not in any way typical, one can, after some experience, have some idea as to whether the case is likely to be confirmed by chemical analysis. I mentioned above the typical smell of faeces and the same smell is noticeable on first opening the carcase. The musculature is a dirty grey red colour throughout. There is some degree of abomasitis and enteritis in nearly all cases. The stomach contents may be searched for flakes of lead paint but these are not always found and their absence should not deter one from suspecting lead poisoning. The liver shows degeneration and is putty-like in consistency. The kidneys in a fresh carcase are very pale with haemorrhagic patches on the surface. When the animal has been dead for some time the surface may be severely haemorrhagic and the kidney very pulpy. The lungs are usually diffusely congested, but not markedly so. There are epicardial haemorrhages and there may be haemorrhages in any other part of the body. Examination of the brain and spinal cord shows that there are meningeal congestion and sometimes quite marked haemorrhages. There may also be haemorrhages in the brain substance. It is said that the brain tissue may be swollen with elimination of the convolutions, but I have never been satisfied that this is present.

Pathology.—Nobody has yet been able to explain satisfactorily the actions of lead in producing the varying symptoms and lesions of lead poisoning. I think that in cases of hyperacute poisoning the chief effect must be a general non-specific one. The presence of a toxic level of lead in the blood leads to various degenerative changes. In organs where the lead level is highest, such as liver and kidney, there is degeneration of parenchymatous cells. Otherwise the lead acts on the intima of the smaller vessels, causing haemorrhage and exudation. There is no doubt that lead produces hypertension by constriction and spasm of the smaller arterioles. Whether this is due to the direct action of lead on the smooth muscle, by central stimulation, or by the stimulation produced by the degeneration of the intima is not known, but undoubtedly there is a primary rise in blood pressure and this, combined with the fragility of the smaller vessels, will increase exudation. I feel that in the hyperacute cases the nervous symptoms are caused by exudation into, and distortion of, the brain tissues. Any specific effects on the nerve cells themselves would not arise until later. There is also some evidence that meningeal irritation occurs, due to the presence of lead in the cerebro-spinal fluid. The apparent blindness mentioned before is thought to be due to spasm of the retinal arteries and consequent transient ischaemia of the retina. Permanent effects seen in man are put down to permanent damage to the retinal vessels or possibly to damage to the optic nerve, but these are in more chronic cases and are unlikely to be seen in calves. The colic seen in acute and subacute cases is due to increased tonicity of the smooth muscle of the intestine. Whether this is due to stimulation of the vagus centre or vagus nerve, or nerve endings, to the depression of the sympathetic supply or to direct action on the smooth muscle, is open to argument. At the moment it appears that the direct action theory is the most likely. There is at least some evidence that by interfering with intracellular enzyme activity in striated muscle, lead has a direct action on this type of muscle and it is possible that a similar type of reaction occurs with smooth muscle. The spasm of the smooth muscle of the intestinal wall causes constipation and colic.

Dr. Allcroft has mentioned the anaemia which arises in cattle when lead is fed over long periods. Blood changes are characteristic of chronic lead poisoning in man and stippling of the red blood corpuscles is a typical early diagnostic finding. Anaemia is due to the direct haemolytic action of lead on the red corpuscles in the circulation and not, in the early stages at least, to any action on the erythropoietic organs. This is shown by the fact that the haemoglobin level falls to a much greater degree than the red blood cell count. It is thought that the haemolysis is produced by a chemical change on the surface of the red blood cell so that it is made more fragile and less resistant to mechanical trauma, thus shortening the life of the cell considerably. Further evidence that this occurs is shown by the increase in serum bilirubin content, increase in urobilin and deposition of haemosiderin in various parts of the body.

That is a brief summary of the probable pathological changes found in lead poisoning in animals. Other manifestations of chronic lead poisoning in man, such as the effects on teeth, bones and joints, and various sense organs and paralysis need not be considered.

The thanks of the veterinary profession and the farming community are due to Dr. Allcroft for this piece of work. Whilst previously we knew that lead poisoning occurred in animals, we are now in a position to have the matter confirmed by accurate chemical analysis, and to take the necessary measures to prevent further cases. We now know what compounds are toxic and where they occur. Moreover, she has pointed out some fallacies in our previous outlook on the causes of lead poisoning, particularly on the matter of lead in the drinking water from lead pipes.

PRODUCING YOUR "RECORD"

It has been suggested that it would be of interest to our readers if they were informed as to the manner in which this journal is produced, the duties involved and the staff employed, and brief reference made to function and policy. It is a proposal to which we are glad to respond and which we welcome, also, as affording the opportunity of indicating methods of mutually helpful co-operation between our contributors and ourselves.

Policy and Organisation

This paper is controlled on behalf of the Council of the National Veterinary Medical Association by an Editorial Committee, of from 15 to 18 members, chosen as being representative of every sphere of activity within our profession. The Committee includes the officers of the Association and is accorded autonomy by Council in all matters other than those involving major expenditure and such as may affect the policy of the Association.

The function of the journal as the official organ of the N.V.M.A. is carried out largely by the publication of supplements, confidential to members, in which are issued the reports of proceedings of Council and of the Branches and Divisions. In addition to the reports mentioned, there are accounts of the meetings of Council of the Royal College of Veterinary Surgeons, which by courtesy of that body are attended by the Association's own reporter. Our "open" columns, from time to time, convey authoritative pronouncements from Headquarters to all members of the profession.

The Editorial Committee has never departed from the interpretation of its primary function as the trustee of the tradition based upon the ideals of its Founder, William Hunting. These were expressed by him in the editorial in his first issue, July 14th, 1888: "We shall publish articles and essays on scientific matters, but, firmly believing that the science of medicine derives even more benefit from the inductive than the deductive method, we shall spare no effort in the attempt to extract from practitioners, clinical reports of all their most interesting and instructive cases." Both statement and aim continue in force, the Editorial Committee constantly having under consideration measures to strengthen the clinical appeal of the *Record*. Steps taken include a short-lived attempt to achieve the desired result by the offer of payment, and a strong appeal to Divisions; this promised well at the outset and its failure at a relatively early date proved a great disappointment: it is hoped that this reminder will revive interest with benefit to the affiliated societies and to the journal. The "Questions and Answers" feature was introduced with this in mind and it is fortified by many expressions of appreciation and wide support by the submission of many queries. It has been suggested that it is not a desirable addition to the journal, but when the matter has been discussed at Society meetings, large majorities have testified to its value. It therefore is true that if our readers require us to be predominantly "the paper for the practitioner," it is they who must make us so, both by direct communication and by the provision of material for the meetings of their local Divisions. It is our own wish, but the hitherto unassailable position of practitioner-contributors as our main source of supply is now being challenged by the flow of articles from scientific institutions; only the practitioner can restore the balance for we live by what we receive. We would venture to ask, nevertheless, whether this arbitrary distinction between science and practice is not outmoded to-day? In this article we can only pose the question, with the comment that our most adversely critical readers almost certainly are the first to absorb the discussion and note the results recorded.

The Committee, under its annually elected Chairman, meets quarterly for the purpose of reviewing the conduct of the journal and dealing with matters referred to it by an Executive Sub-Committee of seven members. It is this body which, in practice, brings out the weekly paper in association with a paid Editor, a member of the profession, who is appointed annually by Council and not elected, as is the Secretary, by the Annual General Meeting. The Executive is a modern creation, and to ensure that the Main Committee maintains really close association with the work, its members are invited to attend the meetings of the Executive Sub-Committee, if they wish, and they also receive the minutes. The Editor has a lady secretarial assistant (the executant on the extensive advertising side) and a junior typist, in whose services the Editorial Department has a half share—a modest staff for a substantial weekly periodical. Grateful acknowledgment, accordingly, has to be made for most willing and helpful assistance from the secretarial and "liaison" staff, together with that rendered by other personnel responsible for matters pertaining to accountancy and circulation.

Voluntary Service

Another valued tradition, that the operations of the Editorial Committee and its Executive do much to preserve, is that of voluntary service. The Committee is greatly indebted to the well-known contributor of invited articles in celebration of historic occasions, and to others. The co-operation of large numbers of experts is enlisted in such matters as the scrutiny of articles and the preparation of notices of books and reports. The complex question of evolving a satisfactory system of scrutiny is a matter that is always before the Main Committee; suffice it to say at the moment that, should a scrutineer recommend rejection of a contribution, the opinion of a second scrutineer is obtained and, in the event of a divergence of view, that of a third. No prior opinions are divulged. The arduous efforts of the "key man" who co-ordinates the intricacies of the abstracts section are dependent, not only upon the remunerated activities of the abstractors and annotators, but also upon the prompt performance of their duties by selectors of articles deemed suitable for abstracting. These they derive from journals available to them, either at the R.C.V.S. Central Library for Animal Diseases—through the medium of world-wide exchanges with *The Veterinary Record*—or from other institutional scientific libraries to whose resources they have access. The Executive decides upon subjects calling for treatment as editorials, and as these are based largely upon the themes of general articles, also upon the writer who, in its judgment, is best qualified to provide well-informed comment. The need for the prompt preparation and insertion of editorials of a topical nature is appreciated and measures are taken to meet it.

Passing, for the moment, to the end of the journal (that which commonly is read first), the Correspondence Section provides the Executive with some serious business and occasional light relief, in consideration of letters upon which either the Editor or his Chairman of Committee may seek an Executive decision. It cannot be stressed too strongly that the guiding principle of the Committee in dealing with correspondence submitted for publication is that every

member has the right to express his views through the medium of his own journal and that, accordingly, no letter should be rejected unless it contravenes the laws of libel, the instinctive professional codes of good taste, or for some other special reason.

A " Policy " book is placed before both committees at each meeting. It furnishes a useful guide to decisions taken over many years, despite the appearance therein of a number of revocations inseparable from changing circumstances and the ultimate proof that certain pious aspirations were inoperable in practice. The exclusion of " original " verse mercifully is not amongst those rulings which have fallen by the way.

The Editorial Angle

The provision of the remaining features of each issue is one of the principal duties of the Editor. Only those who have the onerous task of perusing *Hansard* with a view to reducing to practicable proportions the loquacity of our legislators really know what prolixity means, or what a mass of repetitive questions call for detection and exclusion. The hazards of our natural life constitute a perpetual call to action, while the formidable array of daily and weekly periodicals and the bi-weekly pile of press cuttings demand unceasing attention. It is the job of the Editor, whose hand is in everything, to keep all moving steadily towards the day of publication. The paper goes to press on Wednesday and the Editor has " made-up " his issue on what is known technically as a " paste-down " two days before. This guides the printer as to its major content and it is thus clear that the receipt of late matter creates many problems. The paper has to be printed in multiples of four pages, and endeavours must be made to avoid both the pasting in by hand of an odd double-sided page or the insertion of one carrying " fill-up " advertisements to equalise matters. Occasionally the Editor has to be importunate over the insertion of imperative late matter, but were he to yield to the demands of many who, with little or no justification, forward items accompanied by a call for " insertion in your next issue without fail," chaos would result.

The little feature " Weekly Wisdom " may be mentioned. The Editor has a special regard for it as it provokes the least criticism and provides him with literary exercise (and often much fun) outside his normal veterinary confines. He would like more to have a hand in these selections of what should be restricted to pithily expressed *obiter dicta*, content with the modest reward of seeing their fancy in print.

Preparation for Press

The assurance of timorousness with which, according to his experience, Mr. X drops his article into the village letter box, or Dr. Y finally consigns it to his secretary, is in no way reflected in the manner of its receipt by the ever-welcoming Editor. His immediate reaction is to the manner in which these writers present their matter. By now he knows them nearly all—how refreshing is the new contributor!—ranging from those well-founded in proper arrangement and other points of presentation, to those who, apparently with but the sketchiest idea of what they wish to say, are content to fire off an article, typed in single spacing on both sides of the paper or hastily scrawled in largely illegible script, directing the Editor to " do what he likes with it." Of course, he does his best, but in the hope that a few rules may catch the eye of such as offend, may he remind them that:—

1. Brevity and clarity are the cardinal points of " good writing."*

2. Communications should be typewritten with double spacing and reasonable margins, on one side of the paper only.

3. Sub-headings relieve monotony in reading. (Notes and correspondence are captioned by the Editor.)

4. Essential insertions must be legible.

5. Results can usually be given in words. If, however, despite our concluding section on costs, a contributor insists that his particular article is barren without tabular matter and graphs, they should be separable from the text (being dealt with separately by the printers). Line drawings should be made in India ink on Bristol board; graphs on plain paper or ditto. Photographic positives may be sent, but must be of first-class quality; size is immaterial (within reason)—the requisite reduction or amplification will be made.

6. References should be grouped at the end of the paper and *The Veterinary Record* style of presentation followed strictly, thus:—

The surname of the author quoted should be given in the text, together with the initials (following the name), followed by the year of publication. The list of references, unnumbered,† must be arranged in alphabetical order and indicate author, year, journal, volume and page number. Titles of articles in journals quoted should not be included.

Proof Correction

Every contributor is afforded the opportunity of revising proofs, these being pulled off the set metal in "galley" (*i.e.*, wide-margined paper strip) form and checked prior to dispatch with a request for their prompt correction and return, together with an indication of reprint requirements. Reprints have to be paid for on a quotation basis, but authors are allowed either six free copies of the issue containing their articles, or one dozen sets of " galleys."

Corrections on proofs are very expensive to make; they must be kept to the minimum and the temptation sternly resisted to introduce what it was wished had been thought of before. On press day the final (paged) proofs are dealt with and the effect of the receipt of an extensively amended set of " galleys " at that juncture can be chaotic; it may delay the dispatch of the issue.

For the benefit of those who laboriously write out in full their directions for alterations for which there exists a universally accepted scheme of symbols (or " marks " as they are termed in the trade) we reproduce it herewith. To those on the Active (Writers) List we commend, in particular, a study of the delete sign—a tricky thing to make.

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* It has been well said that "care should be taken not that the reader may understand if he will, but that he must understand, whether he will or no."

† If, however, more than one publication of an author or set of authors is given for one year, these should be marked a, b, etc., and the references in the text should be so marked, *e.g.*, Jones, A. B., 1931a.

ꝺ/	Omit letter or word
tr̃s.	Transpose
stet	Retain words crossed out
/	Insert letter or word indicated
⅟	Insert hyphen
x/	Imperfect letter
w.f.	Wrong fount
//	Words out of line
⊂	Close up
#	Insert space
less #	Reduce spacing
ℙ	Paragraph
/run on	No paragraph
indent	Set type in
Caps	Change to capitals
s.c.	Change to small capitals
ital.	Change to italics
rom.	Change to roman

Costs

This section really merits a bold, black heading. The Editorial Committee has been sustained in its labours by many tributes from eminent veterinarians as to the standard of content and appearance of the journal. Its high reputation abroad has been enhanced since the last International Veterinary Congress and the gracious tributes serve as a spur to the Committee to remedy the many limitations and defects. The Committee is fully conscious of these and they have been stressed by adverse criticisms received from individual members and Divisions.

Within the last few years two *Veterinary Record* Improvement Sub-Committees have deliberated at length upon a vast number of suggestions. In consequence of the more recent enquiry, held only this year, certain drastic changes in content and format are "on paper." There the majority of them, which involve increased expenditure, must remain until printing charges are reduced to reasonable levels. The main item is the colossal cost of paper which at the time of writing is £2,500 per annum in excess of last year's charge; the upward tendency persists, while increases in the costs of all mechanical processes —type-setting, block-making, etc.—are almost equally alarming. These very startling and totally unpredicted increases in expenditure are placing such a heavy strain upon the finances of the Association that it is imperative that ways should be found, in the very near future, of offsetting our costs, and the matter is receiving urgent attention by a small economy committee which has been set up by the General Purposes and Finance Committee.

Meanwhile, far from entering upon an era of overdue development, we are faced with enforced and severe retrenchment, having to rest content for the time being with the consideration of certain minor improvements.

It has, therefore, been decided, reluctantly, to print the *Record* on a paper of cheaper quality which yet will enable it to present a satisfactory appearance and give reasonably good reproduction to such illustrations as can be accepted for insertion under conditions of financial stringency. We are confident that the substitution of its somewhat grey colour and slightly less substantial texture for the glossed "semi-art" to which they have been accustomed will be accepted by our readers as a commonsense change.

It will be appreciated, also, that photographs and other illustrations, together with tabular matter and graphs, must be restricted to the minimum required for the elucidation of the text. The presentation of an undue amount of such material may be regarded as a ground for inability to accept an article; in all cases the author would be consulted as to his willingness to reduce it.

The charges for "display" advertisements are to be increased by approximately 75 per cent. and in spite of this our rates remain at a reasonable level. Neither surprise nor withdrawals from the commercial houses are expected for they find the journal an invaluable medium for bringing their products to the notice of members of the profession. Searching for new advertising is a continuous operation at 36, Gordon Square; we have found, however, that firms outside veterinary and allied orbits are interested almost solely in publications with mammoth popular sales. Nevertheless, in respect of the advertising facilities it has to offer, the *Record*, with its circulation of 5,300 copies amongst veterinarians at home and abroad, has a strong specialised appeal, and we are grateful to those firms which, in response to our most recent approach, have indicated their willingness to take additional space. Our indebtedness will be the greater if, appreciating as they must do the circumstances which have prompted the introduction of new rates, they continue their valued support.

The pile of correspondence, covering every conceivable aspect of veterinary journalism and much besides, accumulates and the task of replying occupies a large part of your Editor's day.

THE CHILLINGHAM CATTLE

"For 30 years prior to 1947 the strength of the famous herd of cattle in the park at Chillingham Castle in Northumberland had been fairly constant at about 35 to 40 head," observes *Nature* in its issue of August 18th, and continues: "After the severe winter of 1947, 13 survived, of which eight were cows, five were bulls and none was young. For 18 months or so no calf was born, and it was feared that the king bull might have become infertile; it was thought that this bull would have to be destroyed to save the herd from extinction. Fortunately, two bull calves arrived and, later, four heifers. The herd now consists of three bulls, seven cows, two bull calves and four heifer cows and now seems to be re-establishing itself. To help in the preservation of this valuable herd, which has almost certainly been at Chillingham Park since 1240, in 1939 an Association was formed. Those who wish to view the herd and apply for membership of the Association should write to the Secretary, Chillingham Wild Cattle Association, Ltd., Estate Office, Chillingham, Alnwick, Northumberland, for further information."

CLINICAL COMMUNICATION

PHENYLMERCURIC DINAPHTHYLMETHANE DISULPHONATE ("PENOTRANE") IN THE TREATMENT OF BOVINE METRITIS

F. G. WADDINGTON, B.V.SC., M.R.C.V.S.,

WATTON, NORFOLK

PHARMACOLOGY

General Properties.—Penotrane is the phenylmercuric salt of dinaphthylmethane disulphonic acid, a compound possessing potent bactericidal and fungicidal properties which are not impaired by the presence of serum, pus and tissue debris.

Tissue Penetration and Concentration.—Aqueous solutions of phenylmercuric dinaphthylmethane disulphonate contain the bactericidal phenylmercuric cation and the colloidal dinaphthylmethane disulphonate anion. This latter confers on the compound the unique properties of penetration of the living epidermis, dermis and subjacent tissues. Furthermore, Penotrane is adsorbed upon tissue protein, thus building up tissue concentrations higher than those in the solution originally applied to the tissue surface. For example, following the application of Penotrane 0·1 per cent. solution to the skin of a rabbit's back, morning and night for three consecutive days, a concentration of 0·28 per cent. phenylmercuric dinaphthylmethane disulphonate was found at a depth of 1·5 mm. below the skin surface; and even at a depth of 2 mm. the concentration was still 0·1 per cent.

Tissue Toxicity.—Notwithstanding the penetrating properties described above, Penotrane does not cause any significant biochemical change in living tissues; as has been demonstrated by Goldberg, Shapero and Wilder.

Thus, muscle cubes from freshly-killed rabbits which had been immersed for 48 hours at 20° C. in solutions containing 0.1 per cent. phenylmercuric dinaphthylmethane disulphonate plus 1·9 per cent. potassium dinaphthylmethane disulphonate at *p*H values ranging from 6·0 to 8·0 maintained their original texture and retained the softness and elasticity of normal fresh muscle. Muscle thus treated is digested by pepsin and by trypsin almost to the same extent as untreated muscle.

Complete gastrocnemius muscles of rabbits, treated in this manner, retained 90 per cent. of their normal elasticity as recorded by the kymograph.

Similarly, rabbit intestine which had been immersed in the 0·1 per cent. solution at *p*H 7·0 for 24 hours was found to be freely permeable to neutral red and fructose—although rather less so than normal intestine.

Influence on the Opsono-Phagocytic Index.—Tubes containing 0·05 c.c. of an emulsion of living *Streptococcus pyogenes*, 0·05 c.c. of a suspension of washed rabbit leucocytes, 0·01 c.c. of normal rabbit serum and varying amounts of the Penotrane solution were incubated for 15 minutes at 37° C. Slides were prepared and 50 polymorphonuclears examined for ingested bacteria with the following results.

0·1 per cent. solution c.c.	Number of ingested bacteria	Opsonic index
Nil	200	4·0
0·01	185	3·7
0·025	174	3·5
0·05	160	3·2

Anti-bacterial Activity.—The following table indicates the maximum bacteriostatic dilutions of Penotrane in multiples of 1,000 after 48 hours' incubation, using p-Chloro-m-xylenol for comparative purposes:—

Compound	Medium	*Staph. aureus*	*Strep. pyogenes*	*E. coli*	*B. subtilis*	*Ps.-pyocyaneus*	*B. proteus vulgaris*
Penotrane	B	250	64	16	10	16	16
	10%S	350	100	25	20	20	20
	50%S	400	120	30	25	30	25
	80%S	400	120	30	25	30	25
p-Chloro-m-xylenol	B	7	7	3·5	3	3·5	3·5
	10%S	4	4	2	1	2	2
	50%S	4	4	2	1	2	2
	80%S	4	4	2	1	2	2

B = Broth; 10% S = Broth containing 10% serum;
50% S = Broth containing 50% serum;
80% S = Broth containing 80% serum.

These figures illustrate the potent anti-bacterial activity of Penotrane against both Gram-positive and Gram-negative organisms, and that this activity is increased rather than reduced in the presence of serum.

The foregoing pharmacological details were extracted by the writer from papers published by Goldberg, Shapero and Wilder in the *Journal of Pharmacy and Pharmacology*.

CLINICAL APPLICATIONS OF PENOTRANE

In human medicine Penotrane is used in various forms. The tincture is an efficient agent for pre-operative skin sterilisation. The 0·1 per cent. solution of Penotrane and a dusting powder containing this compound are used as lotion and dry dressing respectively; for burns, abrasions, infected wounds, impetigo, eczematous conditions and fungal dermatoses. In gynaecology, Penotrane in the form of pessaries and the aqueous solution is used in the treatment of trichomonal vaginitis.

The writer has used this compound both as a lotion and a dry dressing for infected wounds with excellent results. The Penotrane dusting powder has proved to be particularly useful for insufflation into bovine vaginae which have been badly abraded or lacerated during difficult parturitions. In these cases, necrotic changes and gross secondary infections are very common; but these complications have been avoided by the early use of Penotrane as a dressing. In cases seen only after necrosis and infection were already established, daily treatment with Penotrane powder has been very effective. The soothing effect of the dressing is marked by early cessation of straining on the part of the animal; and healthy granulations, followed by healing of the injured vaginae, have quickly become apparent.

Encouraged by the results obtained in treating these superficial conditions and in view of the pharmacological properties described above, the writer felt confident in deciding to use the 0·1 per cent. aqueous solution of Penotrane as an intra-uterine injection in cases of bovine metritis. Before doing so however, he asked the manufacturers to carry out tests at their research laboratories to determine the bacteriostatic activity of Penotrane against *Corynebacterium pyogenes* which was likely to be the predominating organism in cases of purulent metritis. These tests were completed and the following report issued from the laboratory:—

Bacteriostatic Activity of Penotrane Against *C. Pyogenes*

A 1 : 1,000 solution of Penotrane was received for testing. A 1 : 10,000 solution in Horse-flesh Lab : Lemco Glucose broth was prepared and sterilised by steaming for half an hour. The *p*H of the 1 : 10,000 solution was 7·0 to 7·2.

Two-fold serial dilutions were made in 5 c.c. quantities of the same broth and steamed for half an hour before inoculation. Each tube was inoculated with a standard loopful (=0·01 c.c.) of a 24-hour broth culture of *C. pyogenes*.

The results are shown in the table.

Dilution of drug in thousands	1 1 : 10	2 1 : 20	3 1 : 40	4 1 : 80	5 1 : 100
Growth after 48 hrs.	—	—	—	—	—
„ 72 „	—	—	—	—	—
„ 7 days	—	—	—	—	—
Dilution of drug in thousands	**6 1 : 320**	**7 1 : 640**	**8 1 : 1,280**	**9 0**	
Growth after 48 hrs.	—	+	+	++	
„ 72 „	—	+	++	++	
„ 7 days	—	++	++	++	

This sample of Penotrane was bacteriostatic for *C. pyogenes* at a concentration of 1 : 320,000.

. . . . .

It so happened that the writer had the opportunity of trying out the Penotrane solution on a bad case of purulent metritis—which was clinically typical of *C. pyogenes* infection—with remarkably good results, before this laboratory report was forthcoming. The spectacular clinical response—see Case No. 1—obtained with this treatment and the very favourable report on the bacteriostatic action of Penotrane on *C. pyogenes in vitro* convinced the writer that the use of Penotrane solution promised to be a marked advance in the treatment of purulent metritis in cattle.

Treatment of Bovine Metritis

The first seven of the following case histories are records of the treatment with Penotrane solution of cases of bovine metritis which the writer was able to follow, not only to the stage of apparent clinical recovery, but subsequently to his own confirmation of their pregnancy, by rectal examination. Several other cases have been treated similarly with good results—in that the purulent uterine exudates have ceased—but it has not been possible to examine them for pregnancy for various reasons, such as the disposal of a cow from a herd, or insufficient time elapsing since the completion of treatment.

Case No. 8 is one of the latter category, which the writer has recorded here, as the uterus was grossly infected yet showed prompt response to treatment with Penotrane.

Case No. 1.—Shorthorn Cow

History. Calved late May, 1950. Owner reported purulent vaginal discharge commencing about three weeks after calving and continuing with occasional intermissions up to the time of examination. No apparent oestrus since calving.

Examinations and Treatments

17.8.50 Thick purulent discharge, of custard-like consistency, from cervix. Rectal palpation revealed enlarged doughy uterus. Penotrane solution injected into both horns of uterus.

23.8.50 Spectacular response. The mucus in the vagina was copious and crystal clear, except for a few very slight streaks of pus. The improvement was so marked in this case that the writer thought the cowman had kept the wrong animal in, but was assured that this was the same cow! Intra-uterine injection of Penotrane repeated. 25 mg. Stilboestrol diproprionate injected intramuscularly.

1.9.50 Mucus crystal clear. No traces of pus. Uterus normal in size and supple. No further treatment.

15.9.50 Confirmatory examination. Mucus still perfectly clear and owner reported that the cow had shown oestrus the day before.

Service Date. Artificially inseminated, late November.

Pregnancy Examination. 7.4.51. Pregnancy confirmed.

Case No. 2.—Shorthorn Cow

History. Calved June, 1950. No obvious vaginal discharge but owner reported that this cow had failed to conceive after three services by the bull which was fertile on other cows.

Examinations and Treatments

17.8.50 Uterus slightly enlarged and doughy. Slightly purulent thick mucus from cervix. Stilboestrol 25 mg. intramuscularly. Penotrane solution injected both horns of uterus.

23.8.50 Exudate more profuse but still slightly purulent. Penotrane repeated.

15.9.50 Mucus perfectly clear. No further treatment.

Service Date. Artificially inseminated. Mid November.

Pregnancy Examination, 7.4.51. Pregnancy confirmed.

Case No. 3.—Shorthorn Cow

History. Calved May, 1950. No oestrus observed by owner since calving.

Examinations and Treatments

28.8.50 Purulent exudate from cervix. Uterus slightly enlarged and doughy. Ovaries quiescent. 25 mg. Stilboestrol intramuscularly.

15.9.50 Exudate profuse and purulent. Penotrane injected both horns of uterus.

20.9.50 Exudate muco-purulent. Penotrane repeated.

28.9.50 Mucus quite clear. No treatment. Owner reported cow had shown oestrus two days previously.

Service Date. Artificially inseminated. Late November.

Pregnancy Examination. 7.4.51. Pregnancy confirmed.

Case No. 4.—Friesian Cow

History. Calved late September, 1950, a few days before purchased by present owner. Evil smelling vaginal discharge developed a week after putchase.

Examinations and Treatments

9.10.50 Uterus still distended and full of fluid. No intact placenta present but copious exudate of offensive fluid from cervix, with remains of placenta debris. Cow dull and off feed. Stilboestrol diproprionate 25 mg. injected intramuscularly. Two Penotrane pessaries inserted.

16.10.50 Uterus showed considerable involution but copious dark coloured, evil-smelling purulent exudate present. Cow feeding, but not well. Penotrane solution injected both horns of uterus.

20.10.50 Uterus shrinking rapidly. Exudate now muco-purulent with no offensive smell. Cow brighter and feeding well. Penotrane repeated.

9.11.50 Mucus fluid and quite clear. Uterus involuted and cow in good general health.

Service Date. Artificially inseminated 23.1.51.

Pregnancy Examination. 21.4.51. Pregnancy confirmed.

Case No. 5.—Polled Cow

History. Calved 4.10.50. Afterbirth removed manually on 9.10.50 and 25 mg. Stilboestrol intramuscularly. On 12.10.50 the uterus was irrigated with hypertonic saline and the fluid siphoned off. These treatments were applied by the writer's partner, before the writer first saw the animal on 26.10.50.

Examinations and Treatments

26.10.50 Thick purulent exudate from cervix. Uterus still enlarged and doughy. No Penotrane available; so Propamidine isethionate injected into both horns of uterus. Stilboestrol 25 mg. intramuscularly.

31.10.50 Exudate still thick and purulent. Propamidine repeated.

7.11.50 Purulent discharge still present. Stilboestrol 30 mg. intramuscularly.

20.11.50 This long interval was allowed to elapse until further supplies of Penotrane were obtained. Discharge still

present, muco-purulent. Penotrane solution injected both horns of uterus.
1.12.50 Mucus clear with only small flecks of pus. No treatment.
12.12.50 Mucus fluid and quite clear. Cowman reported oestrus on the previous day.
Service Date. Artificially inseminated 19.2.51.
Pregnancy Examination. 1.5.51. Pregnancy confirmed.

CASE No. 6.—AYRSHIRE COW
History. Calved 18.9.50. Purulent vaginal discharge developed about 14 days after calving.
Examinations and Treatments
7.11.50 Muco-purulent discharge from cervix. Penotrane injected both horns of uterus.
15.11.50 Still muco-purulent discharge but much less pus present. Penotrane repeated.
23.11.50 Mucus quite clear. No further treatment.
Service Date. Served by bull 6.12.50.
Pregnancy Examination. 16.3.51. Pregnancy confirmed.

CASE No. 7.—AYRSHIRE COW
History. Calved 14.10.50. Purulent vaginal discharge developed about a fortnight after calving.
Examinations and Treatments
15.11.50 Muco-purulent discharge from cervix. Penotrane injected both horns of uterus.
22.11.50 Mucus quite clear. Penotrane repeated for safety.
Service Date. Served by bull 27.12.50.
Pregnancy Examination. 16.3.51. Pregnancy confirmed.

CASE No. 8.—FRIESIAN HEIFER
History. 27.4.51. The writer was called to attend this heifer which was having difficulty with its first calving. Examination revealed the presence of twin calves which were both dead and in an advanced stage of decomposition with emphysema. The decomposition was so bad that when traction was applied to the foreleg of one calf, this limb came away at the shoulder. Delivery was effected by traction on the calf's head; and again the putrefactive changes were such that the neck stretched by about a foot as the calf was withdrawn. The second calf was also badly decomposed and emphysematous but delivery was accomplished, with some difficulty. The uterine contents then consisted of putrefying placenta and putrid fluid. 10 c.c. Phenergan 5 per cent. solution was injected intramuscularly to counteract shock and toxaemia. 25 mg. Stilboestrol were also injected intramuscularly to hasten involution of the uterus. Acriflavine c Iodoform pessaries were inserted into the uterus.

Further Examinations and Treatments
30.4.51 The heifer was off feed. Temperature 103·4° F. The uterus had shrunk considerably but its contents still consisted of putrid fluid and tissue debris. Sulphanilamide was prescribed orally, initial dose 3 oz., followed by 1 oz. three times daily for three days. Stilboestrol 25 mg. intramuscularly.
3.5.51 Heifer feeding better. Temperature normal. The remains of the placenta were removed manually. Uterine contents much less; but still evil smelling. Acriflavine c Iodoform pessaries repeated and Stilboestrol 35 mg. injected intramuscularly.
17.5.51 The heifer was not seen again until this date as the owner had reported that she was feeding quite well and discharging pus freely from the vagina. At this examination, she was in much better general condition with appetite good. The uterus had now involuted but there was a copious purulent exudate from the cervix. Penotrane injected into both horns of uterus.
22.5.51 Owner reported that the purulent discharge had ceased two days previously, and that the heifer was now giving nearly three gallons of milk daily.
Examination revealed a copious discharge of fluid mucus from cervix with no signs of pus present. This was another spectacular response following the Penotrane injection five days previously. As a precautionary measure, Penotrane solution was repeated in both horns of the uterus, which had shrunk to normal size, and was quite supple when palpated per rectum.
At the time of writing, two days after the last examination recorded above, the writer has not seen the heifer again, but it was evident on 22.5.51 that she was on the way to a complete recovery.

TECHNIQUE OF TREATMENT

In all cases the 0·1 per cent. aqueous solution of Penotrane was used for the intra-uterine injections, which were given by means of a single flow Nielsen's catheter to which was attached a Higginson's enema syringe for pumping the solution from the container into the uterus.

No fixed dose of Penotrane solution was given in these cases; the amount injected depended entirely on the capacity of each horn of the uterus. The average dose was about 2 to 4 oz. into each uterine horn, excepting in recently calved cows when more was needed.

The writer—possibly in common with other practitioners—abandoned the use of Vulsellum forceps years ago, for the operation of passing the intra-uterine catheter. He holds the butt of the catheter in the right hand and guides the tip along the vagina and through the cervix; the latter being gripped with the left hand (protected by rubber glove) per rectum, in exactly the same manner in which the glass pipette is introduced through the cervix in the modern technique of intra-uterine artificial insemination. In this way, nothing is introduced into the vagina except the catheter, the cow shows none of the discomfort associated with the use of Vulsellum forceps and, with practice, the operation is performed more quickly and easily. With this technique it is only on very rare occasions that the catheter cannot be passed through the cervix, whether the cow or heifer has been in oestrus recently or not. It is also much easier to guide the catheter into either horn of the uterus and to be certain that it is in that particular horn.

Furthermore, with this method of passing the catheter, once the tip of the catheter has entered the desired horn, the grip on the cervix may be relaxed and both horns of the uterus are then easily palpable with the left hand while the solution is being pumped into the uterus. The introduction of the solution is continued until each horn is felt to be full and just slightly distended. When this is apparent, the cervix is gripped again and the catheter withdrawn gently, until its tip is again in the vagina just posterior to the cervix. One or two vigorous squeezes are now given to the bulb of the syringe, to spray solution around the entrance to the cervix and over the walls of the vagina.

Reactions Shown by Cows Treated with Penotrane.—The Penotrane solution appears to be non-irritant to the uterus and vagina and most of the cows treated showed no signs of having received the intra-uterine injections. Two or three cows have elevated their tails slightly for a few minutes after the injection, but this was probably due to the handling per rectum and not to any irritation caused by the Penotrane. In no cases was any straining observed and the greater part of the solution was retained in the uterus.

DISCUSSION

The writer is of the opinion that the treatment with the Penotrane solution was the deciding factor in the rapid recovery of these cases of uterine infection. It is possible that the Stilboestrol diproprionate had some adjuvant action in Cases 2, 3, 4, 5 and 8. In the recently calved cows it must have been useful in hastening the involution of the uterus, so that the Penotrane injections were easily given and a smaller quantity of the solution was needed for the treatment. However, even in these cases, the purulent exudates were still present until Penotrane solution was given, after which marked improvement was seen. In no case could it be said that a cow made a natural recovery, independent of the Penotrane treatment, as they had all

had reasonable time to do so before the treatment was applied.

The non-irritant action of the solution and the fact that no straining was caused in the cows is worthy of note. As a result of the absence of straining on the part of the cow, the bulk of the Penotrane solution was retained in the uterus for some time, which must have given it a chance to be adsorbed on to the intra-uterine epithelium and on the protein matter of the uterine contents, thus permitting prolonged anti-bacterial action even after the solution had been expelled gradually by uterine contractions.

The fact that none of the cows relapsed and all conceived easily is further evidence of the efficacy of the Penotrane treatment and shows that the compound had no deleterious effects on the uterine tissues, thus supporting the pharmacologists' report on the insignificant tissue toxicity of phenylmercuric dinaphthylmethane disulphonate.

Corroborative evidence of the harmlessness of Penotrane to the uterus and its efficacy in eliminating bacterial infection from that organ is provided by the fact that three of the cows had maintained pregnancy for five months at the time of the pregnancy examinations. At the time of writing these cows are now six months' pregnant and have not aborted.

The writer is of the opinion that the 0·1 per cent. aqueous solution of Penotrane is a safe and most effective agent for the treatment of purulent metritis in cattle and that his clinical trials of this compound have shown that its therapeutic powers are in accord with its pharmacological properties and bactericidal action described in the preamble of this report.

Summary

1. A description is given of the pharmacology and anti-bacterial activity of Phenylmercuric dinaphthylmethane disulphonate ("Penotrane").

2. Case histories of eight cows treated for purulent metritis by intra-uterine injections of Penotrane 0·1 per cent. aqueous solution are recorded.

3. The technique of the treatment with Penotrane and the reactions shown by the cows are described.

4. The efficacy of Penotrane solution in the treatment of metritis and its harmlessness to the uterine tissues are discussed.

Acknowledgments.—The writer wishes to thank Messrs. Ward, Blenkinsop & Co., Ltd., for the supplies of Penotrane used in these trials and also for providing him with the pharmacological and bacteriological data.

Reference.—Goldberg, *et al.* (1950.) *J. Pharmacol.* **2.** 20. (1950.) *Ibid.* **2.** 89.

Footnote

It is regretted that no data are available to confirm the type of infection present in the cases described above, but from their history and clinical appearance, it is reasonable to assume that *Corynebacterium pyogenes* was a predominating organism in these cases. The writer hopes to obtain cultural evidence of the presence of *C. pyogenes* in selected future cases before treatment with Penotrane, and to show that the uterus is free from this infection after treatment is completed. A short note on these results will be published as soon as data are available.

The first issue of *The Times Review of the Progress of Science* (pp. 16, price 6d.) contains articles on "Freeze-drying" by Dr. E. Hindle, "Insects and Food" by Sir John Simonsen, "Plant Gums and Mucilages" by Professor E. L. Hirst, and "Voluntary Muscle: the Mechanics of its Active State" by Professor A. V. Hill. The supplement will be published quarterly in November, February, May and August.

HISTOLOGICAL COMMUNICATION

SEASONAL VARIATIONS IN THE TESTIS HISTOLOGY OF THE RAM

BY

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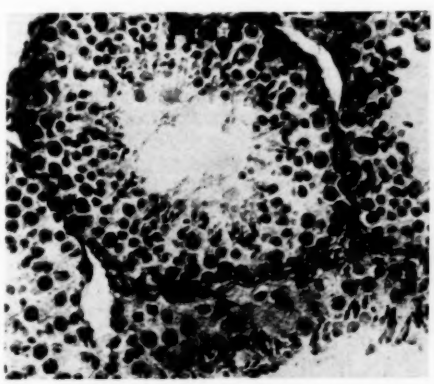
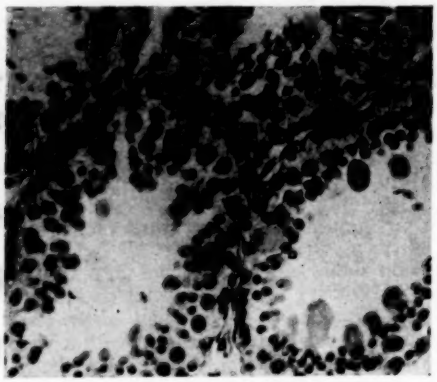
As the ram shows a definite decline in sexual desire and semen qualities during the non-breeding season, it was considered desirable to study the histology of the testes during the breeding and non-breeding seasons with a view to finding out whether there exists any relationship between these functions and testis histology.

Histological examination of the testis sections of the young Suffolk ram during the non-breeding season showed arrested spermatogenesis in the majority of the seminiferous tubules (Figs. 1 and 2). A few of the tubules contained maturing spermia attached to the Sertoli cells. The spermatogenic cells in some of the tubules showed some degenerative changes, *i.e.*, pyknotic nuclei and karyolysis in some cells. The comparative increase in size and number of the protoplasmic droplets in the seminiferous tubules appears to be associated with arrested spermatogenesis. The inter-tubular tissue showed a decrease in the number of the interstitial cells and some of these cells showed atrophic changes. During the breeding season active spermatogenesis was observed in the majority of the seminiferous tubules (Fig. 3). The interstitial cells appeared numerous and well developed.

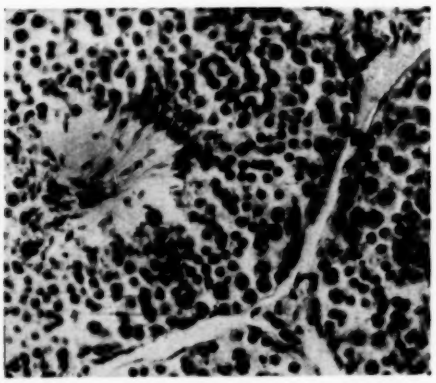
Examination of the semen samples collected by means of an artificial vagina from the young Suffolk rams during the non-breeding season showed a marked decrease in the volume and sperm density, with an increase in the percentage of morphologically abnormal spermatozoa when compared with the values estimated during the breeding season. The main abnormalities observed were headless or tailless sperm and sperm with neck droplets. Moreover, Maqsood (1951)[1] reported a peculiar type of sperm abnormality during the non-breeding season in the ram which was connected with arrested spermatogenesis.



1. Testis section of a young ram (during the non-breeding season) showing arrested spermatogenesis, with a few maturing spermia. The interstitial cells show a comparative decrease in the number and some atrophic changes. H. and E. Stain. × 280.



2. Testis section of an adult ram (during the non-breeding season) showing arrested spermatogenesis and the increase in size and number of the protoplasmic droplets in the seminiferous tubules. × 280.



3. Testis section of a young ram (during the breeding season) showing the degree of spermatogenesis. The maturing spermia with their tails free in the lumina of the tubules are seen attached to the Sertoli cells. Compare with Figs. 1 and 2. × 280.

The poor sexual desire exhibited by the ram during the non-breeding season evidently was due to the interference with the production of the male sex hormone by the interstitial cells which, as mentioned above, showed a decrease in the number and some atrophic changes. The mechanism responsible for the seasonal decline in male fertility in the ram has been discussed by Maqsood (1951).[2]

REFERENCES

[1] MAQSOOD, M. (1951.) Experientia, in the press.
[2] ——. (1951.) Ph.D. thesis, Cambridge University.

WEEKLY WISDOM

If I know, or think I know, the answers I do not trouble to ask questions.—ALLAN FRASER (letter to *The Farmers' Weekly*).

* * * * *

Under the auspices of F.A.O., an intensive anti-rinderpest campaign is being carried out in Afghanistan and nearly 59,000 head of cattle have been immunised.

ABSTRACTS

Nerve Block of the Eye*

The author describes what is claimed to be a simple and satisfactory method of anaesthetising the bovine eye and its associated structures.

Anaesthetisation of the eye is complicated by the fact that six of the 12 cranial nerves are involved in its innervation. In the case of four of these nerves the branches which supply the eye emerge through the foramen orbitorotundum and it is suggested that the site for anaesthetisation is just anterior to this foramen. In order to prevent twitching of the eyelids it will also be necessary to anaesthetise the auriculopalpebral branch of the facial nerve. In the author's opinion anaesthetisation of the optic nerve is not desirable as it consists essentially of the specialised nerves of sight with few, if any, fibres conducting pain; and in addition anaesthetic solution introduced deeply into the bony orbit could be deposited under the extensions of the meninges which surround the optic nerve and could thus reach the vital centres of the brain. The technique employed involves the use of a 4½-inch 18-gauge hypodermic needle which has been curved to correspond with the arc of a circle of 10-inch radius. Using a short needle an insensitive skin weal is produced at the site of the depression just posterior to the point where the supra-orbital process meets the zygomatic arch.

The long needle is introduced through this weal with the point directed slightly downwards and the concavity of the curvature directed posteriorly until the point strikes the coronoid process of the mandible. The point is then passed anteriorly around the coronoid process and the needle inserted until it hits the floor of the pterygopalatine fossa. Since the internal maxillary artery traverses this fossa it is necessary to withdraw the plunger of the syringe slightly to ensure that the needle is not in a blood vessel before injecting 15 c.c. of a 2 per cent. solution of procaine hydrochloride. In order to anaesthetise the auriculopalpebral branch of the facial nerve it is only necessary to withdraw the needle until its point lies just beneath the skin, and then direct it posteriorly in the fascia lateral to the zygomatic arch for 2 to 3 inches while infiltrating the tissue with anaesthetic solution. This nerve block can also be used for dehorning or for trephining the frontal sinus.

S. W. D.

* **Nerve Block of the Eye & Associated Structures.** PETERSON, D. R. (1951.) *J. Amer. vet. med. Ass.* **118.** 145–148.

* * * * *

Studies of Canine Leptospirosis*

As the success of the treatment of canine leptospirosis depends on the early and correct diagnosis of the condition, Newman investigated the value of various diagnostic laboratory tests. Of 30 infected dogs which were examined, the presence of leptospira was demonstrated in seven animals by the direct examination of blood smears with dark ground illumination, while three showed leptospira in the serum stained by Fontana's method. Cultural examination, by the inoculation of blood sediment in Schüffer's modification of Verwoot's medium, revealed the presence of leptospira in six dogs. Serological examination was found to be unreliable in the early stages of the disease. The sera of the dogs were tested for agglutinins with a formal killed suspension of *L. canicola* and *L. icterohaemorrhagiae*, first on admission of the dogs to the clinic and then two and three weeks later. On the first and second test, 14 and 16 dogs, respectively, gave positive results, while on the last

test all dogs showed a high agglutination in their sera.

The author points out the limitation of these tests for early diagnosis, since most of the animals would have died or else be on the way to recovery by the time the titre became positive. A retrospective diagnosis, however, can be established by following the rise in titre in suspected cases. The serological examination proved of real value for the detection of carriers of the disease.

B. W.

* **Studies of Canine Leptospirosis. I. Evaluation of Laboratory Diagnostic Procedures; II. Serologic Determination of the Incidence of Latent Infection in the Lansing, Michigan, Area.** Newman, J. P. (1950.) *Amer. J. vet. Res.* **11.** 405–411.

* * * * *

Toxic Substance from Agenised Wheat Flour*

This paper records the isolation from agenised wheat flour of a toxic substance believed to be identical with that hitherto recovered by Bentley *et al.* (*Nature, Lond.*, 1949, **163,** 675) from agenised zein. It was isolated from an acid hydrolysate of the gluten fraction of flour and is regarded as part of a flour protein.

Degradation experiments suggested that the toxic substance was a derivative of methionine and its probable structure is given.

In discussion it is suggested that while it has not been possible to produce typical epileptiform fits in all animals by feeding agenised flour, it cannot be assumed that the toxic factor is harmless to those species which do not show a nervous response.

A. N. W.

* **The Isolation of a Toxic Substance from Agenized Wheat Flour.** Campbell, P. N., Work, T. S., & Mellanby, E. (1951.) *Biochem. J.* **48.** 106–113.

* * * * *

Surital Sodium Anaesthesia in Canine Surgery*

The authors report the use of surital sodium—a recently developed ultra-short-acting thiobarbiturate—as the sole anaesthetic for 100 operations on dogs. These dogs varied in weight from 7 to 97 lb. and from six weeks to 18 years in age. The surital sodium was employed as a 4 per cent. solution which was prepared by the addition of sterile distilled water to the dry material and used within periods varying from a few minutes to six days. This solution was administered intravenously, about half the estimated dose being given rapidly, followed by small repeated amounts at intervals of approximately one minute, until the required depth of anaesthesia was produced. It was found that the quantity of the 4 per cent. solution required to produce anaesthesia was approximately 1 c.c. per 5 lb. of bodyweight but that, as with the other barbiturates, the dose varied with the age and weight of the dog.

The operations, which varied considerably, were all of comparatively short duration—the average length of operation was 11·5 minutes, and the average recovery time was 1 hour 40 minutes. There was no struggling or other undesirable reaction during the induction of anaesthesia. During recovery from anaesthesia there were no abnormal reactions in 76 cases, in 20 cases there was some excessive salivation, two cases showed movements of the head and leg, one dog died, and another was destroyed before recovery could take place.

S. W. D.

* **Surital Sodium Anaesthesia in Canine Surgery.** Roberts, H. B., Wendt, W. E., Wagner, C. C., & Reutner, T. F. (1951.) *J. Amer. vet. med. Ass.* **118.** 151–153.

Use of Hyaluronidase in Hyperdermochlysis*

The author contends that the addition of hyaluronidase to subcutaneous injections increases their value since it increases the rate of absorption and consequently decreases the possibility of pain, induration or abscess formation.

Hyaluronidase, an enzyme which can be obtained by extraction from such sources as the testicle, semen, snake venom and certain bacteria, acts on the intercellular cementing substance hyaluronic acid. The viscosity of the hyaluronic acid is lowered so that any injection can then diffuse at a more rapid rate. The action of the hyaluronidase is confined to the restricted area immediately surrounding the injection site.

Two illustrative case-histories are set out. In the first one 20 ml. of canine distemper serum together with 1 ml. of a proprietary preparation of hyaluronidase was administered subcutaneously to a five-week-old puppy. Most of the swelling had subsided within one and a half hours and it had disappeared completely the following morning. In the second case (Boston Terrier) a subcutaneous injection of 5 per cent. dextrose saline plus 1 ml. hyaluronidase preparation occupied 20 minutes and produced considerable swelling. The swelling had subsided considerably within one hour and completely in 12 hours without any reaction.

F. R. B.

* **The Benefits in the Use of Hyaluronidase in Hyperdermochlysis.** West, W. R. (1951.) *Vet. Med.* **46.** 98.

REVIEWS

[Questions and Answers Veterinary. Edited by J. V. Lacroix & H. Preston Hoskins. American Veterinary Publications Inc., Box 812, Evanston, Illinois. Price $4·00, U.S.A., $4·25 elsewhere.]

This book is a collection of 500 selected questions submitted to the *North American Veterinarian* since 1945; and answers by 138 authorities and the editorial staff.

The questions cover a wide range of subjects relating to horses, cattle, sheep, goats, pigs, dogs, cats, poultry, etc.

The questions and answers are grouped together in related subjects, the index serving to direct the reader quickly thereto.

The information contained in the answers, although condensed, is up to date and helpful. The veterinarian in practice will find in this book not only a source of quick reference to a wide range of disorders met with in everyday work, but a fresh approach to some of the problems with which he is constantly faced.

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[Restraint of Animals. By John R. Leahy, D.V.M., M.S., and Pat Barrow, Medical Illustrator, Department of Anatomy, Cornell University. Obtainable through the Cornell Co-operative Society, Ithaca, N.Y., price $3·50]

This book was prepared for the use of third and fourth year veterinary students at Cornell, as a supplement to their clinical work. Every known method of physical restraint is described adequately by diagram and text, but unfortunately no more than bare reference is made to restraint by sedation and anaesthesia, which are used increasingly in modern practice. However, the book contains over 300 excellent drawings of other methods of restraint—it covers basic rope and knot work and the methods of handling the domestic animals, large and small, fur-bearing animals and poultry—and so may be found useful for reference.

NOTES AND NEWS

Diary of Events

Sept. 20th.—Open Field Day at Tean Cattle Breeding Centre, Stoke-on-Trent, Staffs, 2 p.m.

Sept. 22nd.—300th Meeting of the Biochemical Society, at the Rowett Research Institute, Bucksburn, Aberdeenshire, 11 a.m.

Sept. 24th.—Annual General Meeting of the Association of Veterinary Teachers and Research Workers at Eastbourne (Grand Hotel), 11.30 p.m.

Sept. 27th.—Annual General Meeting and Dinner of the Royal (Dick) Veterinary College Alumnus Association at Eastbourne. (See Notice.)

Sept. 23rd-29th.—Sixty-ninth Annual General Meeting and Congress of the National Veterinary Medical Association, at Eastbourne.

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N.V.M.A. Congress at Eastbourne

APPLICATION FOR TICKETS

There are still a few tickets left for some of the Congress functions and any members who have not yet applied are asked to do so without further delay.

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PERSONAL

Birth.—DAVISON.—On September 3rd, 1951, at the Holmewood Nursing Home, West Bridgford, to Rita (*née* Brooks), wife of Frank L. Davison, M.R.C.V.S., a daughter—Patricia Rita.

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R.C.V.S. OBITUARY

CLIFFORD, W. A., 345, London Road, St. Leonards-on-Sea, Sussex. Graduated London 1887. Died September 9th, 1951; aged 87 years.

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S.V.R. OBITUARY

WALTON, John Septimus Ross, 262, Wylds Lane, Worcester. August 15th, 1950, No. 118. Died March 28th, 1951; aged 78 years.

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C.M.O. ADVOCATES HEAT TREATMENT OF ALL MILK

In his first report as Chief Medical Officer of the Ministry of Health, Sir John Charles states that in 1949 deaths from all forms of tuberculosis showed a remarkable decline of 10 per cent. from those in 1948. The decline was due to a reduction of 8 per cent. in deaths from respiratory tuberculosis and one of 19 per cent. in deaths from other forms. "At a conservative estimate," the report states, "30 per cent. of these deaths from other forms of tuberculosis are due to infection by bovine strains of the tubercle bacilli, conveyed by milk. In this country some 80 per cent. of liquid milk is now heat treated and heat treatment of the remaining 20 per cent. would still further reduce these deaths from other forms of tuberculosis."

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METHYLATED SPIRITS

Under the Methylated Spirits Regulations (S.R. & O. 1930, No. 832) veterinary surgeons (persons duly registered in the Register of Veterinary Surgeons) may receive and use industrial methylated spirits, and pharmacists may sell industrial methylated spirits and articles made with industrial methylated spirits on the orders or prescription of veterinary surgeons. New regulations (S.I. 1951, No. 1470) have now been made which extend these facilities to apply in the case of registered veterinary practitioners (persons registered in the Supplementary Veterinary Register).

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DDT POISONING OF CATS AND DOGS

In its issue of August 25th, *The Pharmaceutical Journal* observes: "The Royal Society for the Prevention of Cruelty to Animals have written to us in respect of the dangers of applying DDT powders and dressings to dogs and cats for the destruction of skin parasites such as fleas and lice. During the past five or six years the Royal Society have approached a number of DDT manufacturers and have persuaded them to include a warning notice on the labels of their products, but such action has not yet been taken by all makers of these preparations. We are therefore asked to request pharmacists to inform customers who desire to purchase DDT products for application to dogs or cats that a real danger of poisoning the animal exists. The Royal Society inform us that in their own clinics gammexane preparations are used, since this substance has been found to be much less toxic than DDT."

ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

SWINE FEVER:

Beds.—Park Farm, Steppingley (Sept. 5th).

Cambs.—Colsore Farm, West Street, Isleham (Sept. 4th).

Derbyshire.—Home Farm, Ripley Road, Heage (Sept. 7th).

Hunts.—Park Hall Road, Somersham (Sept. 6th); Colne Fen Drive, Colne; High Fen Farm, Warboys (Sept. 7th).

Isle of Ely.—54, High Street, Whittlesey (Sept. 4th); West Fen Road, Ely; 14, West End, Whittlesey (Sept. 5th); 25, Wimpole Street, Chatteris (Sept. 6th); Blabys Drove, Sutton Fen, Sutton, near Ely (Sept. 7th).

Lanarks.—Meiklehill Farm, Bishopbriggs (Sept. 3rd).

Lancs.—Farnworth Close Farm, Church Street, Westhoughton (Sept. 4th); 6, Clarke's Crescent, Eccleston (Sept. 5th); Furtherheights Farm, Heights Lane, Rochdale (Sept. 6th).

Lincs (Kesteven).—Grange Farm, Harmston (Sept. 5th).

Lincs (Lindsey).—Top Road Farm, Asgodby (Sept. 4th); Wesley House Farm, Commonside, Crowle (Sept. 6th).

Norfolk.—Edgar Farm, Great Walsingham (Sept. 3rd); Manor Cottage, Hoe, East Dereham (Sept. 5th).

Northants.—North Lodge Farm, Isham (Sept. 6th).

Notts.—335, Berry Hill Lane, Mansfield (Sept. 5th).

Staffs.—Theplow Inn, Brereton, Rugeley (Sept. 5th); Newlands Cottage Farm, Highwood, Uttoxeter; Garsty Hill Farm, Yarnfield, Stone (Sept. 7th).

Suffolk (East).—Milestone Dairy, Melton, Woodbridge (Sept. 5th).

Suffolk (West).—Fox Farm, Great Bradley (Sept. 3rd); Lackford Manor, Lackford (Sept. 4th); 31, Council Houses, Beck Row, Bury St. Edmunds (Sept. 6th).

Yorks (N.R.).—Marfield Gardens, Masham, Nr. Ripon (Sept. 4th).

Yorks (W.R.).—Poplar House Farm, Burn, Selby (Sept. 3rd); Garden 7, 2nd Avenue, Watchhouse Lane Allotments, Benkley (Sept. 4th); Club House, Smithey Green, Smithies, Barnsley; Old Hall Farm, Warley, Halifax (Sept. 7th).

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VACCINATION AGAINST CONTAGIOUS ABORTION WITH S.19

In a recent announcement the Ministry of Agriculture states that during the last few years there has been a steady increase in the average yield of milk per cow in Great Britain. Several factors have helped to bring this about, but there is no doubt that the protection of dairy animals against contagious abortion by vaccination with S.19 vaccine has played an important part.

"The Ministry of Agriculture and Fisheries operates a Calf Vaccination Scheme to help farmers to take advantage of this method of immunising their animals against contagious abortion at the most important time, namely, from four months old up to the time of first service. The charge for vaccination under the scheme is only 2s. per animal. It has been estimated that during the lactation following abortion the loss of milk of a cow is of the order of 25 per cent. This represents a serious loss to the farmer, apart from the loss of the calf. Two shillings per animal is a small amount to pay for protection against the risk of such loss.

"Farmers, particularly dairy farmers, who have had heifer calves vaccinated under the scheme are strongly advised to go on with vaccination, and to make sure that all heifer calves and maiden heifers up to the time of first service are presented for vaccination.

"Newcomers can join the scheme at any time. Just send a postcard to the Ministry's Divisional Veterinary Officer, telling him that you wish to join and stating the name of your veterinary surgeon."

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NATIONAL BOOK LEAGUE TRAVELLING EXHIBITION

A cultural feature of the Festival of Britain that deserves to be more widely known is the Travelling Exhibition of 1,001 books organised by the National Book League, 7, Albemarle Street, London, W.1. The distinction of the selection of the third edition of his "Diagnostic Methods in Veterinary Medicine" to represent current veterinary literature is one upon which Professor Geo. F. Boddie, of the University of Edinburgh Veterinary School, is to be congratulated. Full particulars of forthcoming Exhibition visits gladly will be sent on application to the Secretary of the National Book League, telephone Regent 1201.

THE BLOWLAMP AS A CAUTERY IN THE CASTRATION OF HORSES

Mr. A. Hart, M.R.C.V.S., of Ardnadam, Dunoon, Argyle, writes: "About 30 years ago I adapted a blowlamp to heat an iron, constituting a self-contained unit, for use in castration by the chloroform standing, clam and cautery method and looked after the heating of the iron myself.

"When over 70 years of age I castrated two yearling cart colts, but took a plumber's apprentice with me who was used to blowlamps, to look after the heating of the iron. When the first testicle was exposed and the cord with the testicle was in the clam, the apprentice appeared and told me the lamp had gone out and the iron was cold. I was placed in a very difficult position in a field in a downpour of rain, the colt under chloroform, the only restraint a rope doubled round the heel of the uppermost hind leg and the leg pulled forward to the shoulder, and with nothing to finish the operation. I asked if the plumber's blowlamp was in order and being told that it was, had it brought to me immediately. Severing the cord, I seared the blood vessels with the direct flame of the blowlamp and finished the operation, dealing with the other colt in the same manner.

"From my limited experience I formed the opinion that the blowlamp was quicker and more efficient than the hot iron, while the heat can be controlled according to the distance the flame is kept from the cord

"If any practitioner should wish to try the method, small blowlamps are manufactured with the flame at right angles to the handle and would be ideal for the purpose."

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BRITISH COW'S WORLD RECORD

Manningford Faith Jan Graceful, a black and white Friesian cow, at Blackbourton, Oxon., has passed the lifetime yield record of the American Holstein Ionia Ormsby Queen, 267,304 lb. of milk. The record set up in 1938 was passed by 11 lb. She also took four years and nine months off the time for accomplishing the feat. Ormsby Queen was 18 when she died. Graceful, bred by Mr. G. M. Odlum and owned by R. and H. Jenkinson, is 13 years, three months.

During her milking lifetime Graceful has produced 70 lb. of milk a day. A few months ago she set up a record by being the first British cow ever to yield more than 100 tons of milk.

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EUROPEAN MILK RECORDING

A further meeting of the recently constituted European Committee on Milk-Butterfat Recording was held at The Hague on Saturday, July 14th. Representatives were in attendance from Austria, England, France, Germany, Luxembourg, Netherlands, Norway, Scotland, Sweden, and Switzerland. At this meeting the constitution of the Committee was formally approved and adopted, and the following office-bearers were appointed:—President, Professor A. M. Leroy (France); Vice-President, Mr. James A. Paterson (Superintendent-Secretary, Scottish Milk Records Association); Treasurer, Dr. C. J. M. Rijssenbeck (Holland).

"This new organisation has been brought into being," observes the *Scottish Farmer*, "in order that a unified scheme of milk recording should, in time, operate through all the European countries where milk recording is practised. The scheme of recording adopted, which was agreed upon at a conference held in Rome in the month of March, is in all the main details the Scottish Scheme of Recording as it has operated since 1903. Representatives of the Scottish Milk Records Association were present at the Rome Conference, and took a very active part in the drawing up of the conditions governing this unified scheme. It seems only right that a major part of the control of the scheme should be vested in an official of the Scottish Milk Recording body."

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REDUCTION IN THE DAIRY HERD

"Uneasiness at certain trends shown in the June farm census returns (observes the *Farmers' Weekly*) is expressed by the National Farmers' Union. The Union is particularly anxious about the reduction of more than 100,000 head in the dairy herd. This is attributed in part to the discouraging effect of recent price decisions.

"The big drop in the number of calves, notably female calves, is described as 'most disconcerting for the future of milk and beef production.' A serious effect on milk output is anticipated.

"Reference is made to the effect of the bad winter on the expansion rate for sheep, while satisfaction at the increase in pig numbers is qualified by the consideration that it will make heavier demands on feeding-stuffs supplies."

LEGAL NOTES

Contravention of Transport of Animals Order
Railway Executive and Farmer Fined

At Sturminster Newton (Dorset) Justices' Court on August 8th, both the Railway Executive and the consignor of three cows being sent by rail to a knackerman at Shoreham-on-Sea, Sussex, were fined £15 and ordered to pay 5 guineas costs for permitting their carriage on the railway when, owing to infirmity, this must involve unnecessary suffering during the intended transit. Pleas of not guilty were entered both by the Railway Executive, represented by Mr. P. G. Hayward, and by the consignor, Trevor Rowland, a Bagber farmer and cattle dealer.

Mr. L. St. Bel Golledge, a Sherborne veterinary surgeon, said (reports *The Western Gazette*) that he was called to Templecombe Station at about 9 p.m. on June 1st. In a truck he saw a roan cow, in an emaciated condition, down on her side and unable to rise. It was unfit to undertake a rail journey, and he destroyed it. Seven other cows in a lair near the truck were in a poor condition. Two of them especially were emaciated and coughed.

Captain John Fox, Superintending Veterinary Officer of the Animal Health Division of the Ministry of Agriculture, Bristol, who inspected the animals two hours later, told Rowland that two of them, a roan and a red, would be prohibited from travelling by rail to their destination, but that he would, if he wanted, take them to the nearest knacker's. He told Rowland that the other five, although in poor condition, were borderline cases, and he could take them where he liked.

Asked why the cattle were consigned to Shoreham-on-Sea, Rowland said that the man they were consigned to, who witness understood was a knackerman, had a better trade for them on the black market.

The next morning, said Captain Fox, he saw the carcases of the roan and the red at a knackery at Stourton Caundle. The red showed advanced tuberculosis, and so did the roan which the veterinary surgeon had destroyed In addition there were bruises on her right side. The other roan cow, which was destroyed at the knackery, showed evidence of old standing pneumonia. All three carcases were devoid of fat and could be described as skin and bone, and were never fit to travel.

Mr. Hayward: Do you see many thin cattle in the course of your duties?—Captain Fox: Unfortunately I do, because there is a trade in them to-day and we are trying to stop it.

P.C. Cowling said Rowland told him that in his opinion the cattle were perfectly fit to travel anywhere, and the railway people were of the same opinion, else they would not have loaded them. They were loaded at Sturminster Newton

The Defence

Mr. M. W. Gilbert, the Sturminster Newton stationmaster, said, in a statement, that he was responsible for accepting eight cattle for conveyance by train, and in his opinion they were in a fit condition to travel, as prior to loading they were walking about the cattle pens and showed no outward signs of illness or lameness.

For the defence, Morley Walter Gilbert said he inspected the cows in a pen at the station before they were loaded in accordance with instructions. He did not notice any of them coughing or walking with their back legs crossed. There was nothing in their condition to make him suspect they were unfit to travel. In his opinion they were not unduly thin. He did not know they were being consigned to a knacker. Supporting evidence was given by a porter and a goods checker at the station, also by the guard of the train on which the cattle were consigned.

Rowland told the magistrates that the cows were knacker cows which were consigned to a knacker. The cows had been on the rail roughly five hours when seen at Templecombe. They were probably shunted at Templecombe for an hour or more, and it was probably during the shunting that one of them got down and could not rise because other cows were over it. Similar accidents occurred every day on the railway. "If this particular cow had not gone down nothing would have been said," he added. He agreed they were thin, but they were not emaciated.

Replying to Mr. Cooper, Rowland agreed that there was a knacker's nearer than the place to which the cows were being sent.

Mr. Hayward submitted that the Executive had done everything in their power to see that humanitarian principles had been followed.

It was the Templecombe stationmaster who, obeying the strict instructions laid down in the railway handbook concerning animal transit, got in touch with the veterinary surgeon, he said.

. . . . .

What is a Draught Horse?—When a horse-van driver was fined £1 at Garstang, Lancs, for "carrying two heavy draught horses in

a road vehicle without ensuring they would stand facing either front or rear of the vehicle throughout the journey," it was submitted as defence that the two horses—a two-year colt and a three-year gelding, both unbroken and unshod—did not come within the category of "heavy draught horses."

Mr. William Brock, a Royal Lancs Show judge, of Warrington, to whom the horses were being delivered, contended that it would be highly dangerous to tie young horses which had never worn halters. The possibility of an appeal is being considered.

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FOXGLOVES IN MEDICINE

The Wellcome Film Unit has completed a 16 mm. sound film in colour (running time, 26½ minutes) entitled "Foxgloves in Medicine." After a brief historical survey of the early uses of foxglove, the discovery and production of digoxin is described. Pharmacological action is demonstrated on isolated animal hearts and its therapeutic value indicated. Animated diagrams illustrate the relation between heart action and electrocardiograms. The film ends with a sequence showing two patients, before, during and after treatment with digoxin. Two other films recently completed are "Movements of the Rabbit's Alimentary Canal" and "Venomous Snakes—Medical Aspects." Applications for copies of the film should be made to the Wellcome Film Unit, 183/193, Euston Road, London, N.W.1.

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SCOTTISH GALLOWAY CATTLE FOR AUSTRALIA

In a contribution to the August 13th issue of *The Meat Trades Journal*, Mr. M. Thompson records that Scottish Galloway cattle, a breed renowned for hardiness and quick maturing qualities under extreme winter conditions, were introduced into Australia for the first time recently. A shipment of two bulls and eight heifers reached Sydney, New South Wales, in April, 1951. These cattle will form the nucleus of herds which, it is expected, will prove admirably adapted to winter conditions in the Australian highlands, where severe frosts are experienced.

"Standard breeds of beef cattle, unless hand fed, are inclined to lose condition during the mid-winter months in some of the highland and tableland districts in New South Wales and Victoria. However, the tough Galloways, which stand up to the rigours of Scotland's frigid winters, should find the more temperate conditions in their new clime greatly to their liking."

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COLONIAL STUDENTS' WELFARE

The Secretary of State for the Colonies, Mr. James Griffiths, is to establish a small consultative committee to advise him on matters concerning the welfare of colonial students in the United Kingdom. He has decided to invite to the committee, in addition to representatives from the Colonial Office and the British Council, a member of Parliament from each of the three leading parties, a representative from one of the universities and representatives of the colonial students.

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N.I. MINISTRY REJECTS FOAL SUBSIDY SCHEME

The Ministry of Agriculture, Northern Ireland, has informed the Tyrone Committee of Agriculture that no useful purpose would be served by the introduction of a subsidy for foals. The Ministry, it was added, was not prepared to introduce such a scheme, more especially as many young horses were at present being sold for their flesh. Horse-breeding was already being subsidised to a considerable extent and the Ministry felt that further support from public funds would not be justfied, even as an insurance against the future.

Although the Ministry already has rejected an earlier plea (*Vet. Rec.* **63**, 487), the Committee adopted a resolution from Down County Committee of Agriculture requesting that owners who lost animals as a result of outbreaks of anthrax should be compensated. The resolution also urged that measures be taken to prevent the spread of anthrax.

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"JOB FOR THE HORSE"

"How many of us realise that it is costing us from £4 to £6 a day to keep one man and a tractor at work? And how many of us have stopped to ask ourselves whether we are frequently outrunning our sense and our pockets by employing 20 horse power where one or two would do the job?"

These questions are put by an editorial writer in the September issue of the *Dairy Farmer*, who continues: "I know the arguments against the horse, but a good many farmers agree with me that there are hosts of lighter jobs that he can do better than any tractor providing you can get someone to take his backside off the tractor seat and walk with the horse.

"But I am not sure I haven't found the answer. I saw it in the streets of a large town—two horses pulling what is known as, I believe, a "monkey." It was a light 4-wheeled frame incorporating a comfortable well-sprung seat and a tow-bar to which a garbage trailer was attached. This tow-bar would have taken any tractor-drawn implement with ease, and I'm sure two horses would pull the muck-spreader behind it and leave far shallower ruts in the land than the tractors did last year. And I doubt if the cost would be any more than £2 a day.

MINISTRY HELP

"Unfortunately our horse population has so shrunk that the once-thriving heavy horse societies that travelled stallions have closed down. They had grants to hire the stallions but the mare population was so thin that the cost of transporting the stallions over wide areas proved too great. However I hear that so anxious are the Ministry to rejuvenate these societies that in at least one case they have made a tentative offer of £250 towards the transporting costs; and that is quite apart from the hiring grant."

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The most serious outbreak of foot-and-mouth disease since 1939 has spread from South Germany to the British zone and now affects about 250 places in North Rhine Westphalia, the State Government announce. The German authorities were unable to fight it successfully, a spokesman said, because there was an acute shortage of vaccines, but the West German Federal Government was trying to import them from Denmark and Italy.

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The Institute of Seaweed Research at Musselburgh, the Experimental Farm of the East of Scotland College of Agriculture and the Rowett Institute for Research in Animal Nutrition are co-operating in a new set of investigations for the furtherance of the utilisation of seaweed products in rations for livestock. Digestibility and energy trials will be made with sheep and group comparison feeding trials with pigs.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Fowl Pest	Parasitic Mange*	Sheep Scab	Swine Fever
Aug. 1st to 15th 1951	14	—	32	—	—	71
						8
Corresponding period in—						
1950	17	—	1	—	—	—
1949	8	—	15	—	1	—
1948	7		15	—	2	
Jan. 1st to Aug. 15th, 1951	289	26	586	—	4	636
Corresponding period in—						
1950	250	16	101	—	19	51
1949	122	11	352	—	29	5
1948	62	—	230	1	31	22

* Excluding outbreaks in Army Horses.